R E P O R T R E S U M E S

ED 015 604 EC 001 155

AN INVESTIGATION OF THE DOMAN-DELACATO THEORY OF NEUROPSYCHOLOGY AS IT APPLIES TO TRAINABLE MENTALLY RETARDED CHILDREN IN PUBLIC SCHOOLS.

BY- KERSHNER, JOHN R.
PENNSYLVANIA STATE DEPT. OF PUBLIC INSTRUCTION

PUB DATE MAY 67

EDRS PRICE MF-$0.50 HC-$4.76 117P.

DESCRIPTORS- *TRAINABLE MENTALLY HANDICAPPED, *NEUROLOGICAL ORGANIZATION, *INTELLECTUAL DEVELOPMENT, *PHYSICAL DEVELOPMENT, CHILDREN, EXPERIMENTAL PROGRAMS, INTELLIGENCE QUOTIENT, PERCEPTUAL MOTOR LEARNING, PHYSICAL ACTIVITIES, PHYSICAL EDUCATION, PSYCHOMOTOR SKILLS, PUBLIC SCHOOLS, RESEARCH PROJECTS, *EXCEPTIONAL CHILD RESEARCH, DOMAN DELACATO DEVELOPMENTAL PROFILE, KERSHNER DUSEWICZ KERSHNER REVISION, OSERETSKY TESTS OF MOTOR PROFICIENCY, PEABODY PICTURE VOCABULARY TEST.

THIS STUDY USED TWO INTACT CLASSES OF PUBLIC SCHOOL TRAINABLE MENTALLY RETARDED CHILDREN TO STUDY THE EFFECTS OF PHYSICAL ACTIVITIES DERIVED FROM THE DOMAN-DELACATO THEORY OF PHYSICAL AND INTELLECTUAL DEVELOPMENT. THE EXPERIMENTAL GROUP CONSISTED OF SEVEN MALES AND SIX FEMALES FROM AGE 8 TO 18 AND THE CONTROL GROUP CONSISTED OF 10 MALES AND SIX FEMALES FROM AGE 8 TO 17. ALL SUBJECTS WERE GIVEN THE FOLLOWING PRE- AND POST-TESTS--(1) A MOBILITY SCALE DERIVED FROM THE DOMAN-DELACATO DEVELOPMENTAL PROFILE, (2) THE KERSHNER-DUSEWICZ-KERSHNER REVISION OF THE VINELAND ADAPTION OF THE OSERETSKY TESTS OF MOTOR PROFICIENCY, AND (3) THE PEABODY PICTURE VOCABULARY TEST. THE EXPERIMENTAL PROGRAM WAS EXTENDED THROUGH 74 TEACHING DAYS THAT APPROXIMATED FIVE AND ONE HALF HOURS EACH AND INCLUDED ACTIVITIES CONSISTENT WITH THE DOMAN-DELACATO THEORY. FOR THE CONTROL GROUP THE CURRICULUM INVOLVED A NUMBER OF NONSPECIFIC ACTIVITIES THAT COULD GIVE OPPORTUNITIES FOR PRAISE AND ATTENTION EQUAL TO THAT RECEIVED BY THE EXPERIMENTAL GROUP. HYPOTHESIS ONE STATING THERE IS A SIGNIFICANT IMPROVEMENT IN CREEPING AND CRAWLING PERFORMANCE FAVORING THE EXPERIMENTAL GROUP WAS ACCEPTED SINCE THE MANN-WHITNEY U TEST COMPARING PRE-POST-TEST GAIN SCORES BETWEEN GROUPS FOUND DIFFERENCES WERE STATISTICALLY SIGNIFICANT AT THE .05 LEVEL. HYPOTHESIS TWO STATING THERE IS A SIGNIFICANT IMPROVEMENT IN PERCEPTUAL-MOTOR PROFICIENCY FAVORING THE EXPERIMENTAL GROUP WAS REJECTED SINCE THE MANN-WHITNEY U TEST COMPARING PRE-POST-TEST GAIN SCORES BETWEEN GROUPS FOUND THE DIFFERENCES WERE NOT STATISTICALLY SIGNIFICANT AT THE .05 LEVEL. HYPOTHESIS THREE STATING THERE IS A SIGNIFICANT MEAN IQ IMPROVEMENT FAVORING THE EXPERIMENTAL GROUP WAS ACCEPTED SINCE AN ANALYSIS OF VARIANCE PRODUCED CORRELATION COEFFICIENTS BETWEEN THE PRE-TEST AND POST-TEST SCORES FOR THE EXPERIMENTAL AND CONTROL GROUPS OF .81 AND .95 RESPECTIVELY AND A DIFFERENCE STATISTICALLY SIGNIFICANT AT THE .05 LEVEL. THE TREATMENT HAD A FACILITATING EFFECT ON BOTH THE PHYSICAL AND INTELLECTUAL DEVELOPMENT OF THE EXPERIMENTAL GROUP. REPLICATION AND LARGER SCALE INVESTIGATIONS ARE NEEDED. APPENDIXES INCLUDE THE CREEPING AND CRAWLING SCALE AND THE KERSHNER-DUSEWICZ-KERSHNER REVISION OF THE VINELAND OSERETSKY TESTS OF MOTOR DEVELOPMENT. BIBLIOGRAPHY LISTS 56 ITEMS. (DF)

ED015604

BUREAU OF RESEARCH
ADMINISTRATION AND COORDINATION
AREA OF RESEARCH AND DEVELOPMENT
DEPARTMENT OF PUBLIC INSTRUCTION
COMMONWEALTH OF PENNSYLVANIA

An Investigation of the Doman-Delacato Theory of Neuropsychology As It Applies to Trainable Mentally Retarded Children in Public Schools

May 1967

Initiator and Principal Investigator
JOHN R. KERSHNER

SEP 25 1967

COMMONWEALTH OF PENNSYLVANIA
DEPARTMENT OF PUBLIC INSTRUCTION
BOX 911, HARRISBURG, PA. 17126

In order to clarify the position of the Department of Public Instruction regarding the enclosed study, the following points need to be emphasized:

1. The study was a master's degree thesis at Bucknell University;

2. Rather than definitive conclusions, the study points up the need for more rigorous and larger scale experiments;

3. While no bias was intentionally introduced, the applicability of the findings to other teachers, groups, schools, or geographical regions depends on the unknown degree to which this sample is representative of the population about whom the findings are generalized; and

4. The Department of Public Instruction of Pennsylvania does not officially endorse nor recommend the procedures under investigation.

U.S. DEPARTMENT OF HEALTH, EDUCATION & WELFARE
OFFICE OF EDUCATION

THIS DOCUMENT HAS BEEN REPRODUCED EXACTLY AS RECEIVED FROM THE PERSON OR ORGANIZATION ORIGINATING IT. POINTS OF VIEW OR OPINIONS STATED DO NOT NECESSARILY REPRESENT OFFICIAL OFFICE OF EDUCATION POSITION OR POLICY.

Bureau of Research
Administration and Coordination
Area of Research and Development
Department of Public Instruction
Commonwealth of Pennsylvania

AN INVESTIGATION OF THE DOMAN-DELACATO THEORY OF NEUROPSYCHOLOGY AS IT APPLIES TO TRAINABLE MENTALLY RETARDED CHILDREN IN PUBLIC SCHOOLS

May 1967

Initiator and Principal Investigator

John R. Kershner

TABLE OF CONTENTS

ACKNOWLEDGMENT v

LIST OF TABLES vii

SECTION A, INTRODUCTION

CHAPTER I, Introduction 1

CHAPTER II, Overview 3

SECTION B, RELATED STUDIES

CHAPTER III, A Critical Review of Related Literature 6

CHAPTER IV, Background of Experimental Research on Physical Education Programs for the Mentally Retarded 12

CHAPTER V, Background of the Theory of Neuropsychology 15

CHAPTER VI, A Preliminary Pilot Investigation 18

SECTION C, METHOD

CHAPTER VII, Statement of Purpose 19

CHAPTER VIII, Procedure 20

CHAPTER IX, Pre-treatment Analysis 29

CHAPTER X, Questions and Hypotheses 32

CHAPTER XI, Program 34

CHAPTER XII, Supervision 43

CHAPTER XIII, Limitations 44

SECTION D, FINDINGS

CHAPTER XIV, Final Analysis and Results 46

SECTION E, DISCUSSION

CHAPTER XV, Summary, Conclusions and Implications 52

BIBLIOGRAPHY 55

APPENDIX A 60

APPENDIX B 63

APPENDIX C 104

SECTION A

INTRODUCTION

LIST OF TABLES

TABLE 1, The number of subjects in each group 21

TABLE 2, Pre-test scores 29

TABLE 3, t analysis of pre-treatment scores for the two groups 30

TABLE 4, Mann-Whitney U analysis of pre-treatment scores for the two groups 31

TABLE 5, Post-test scores 46

TABLE 6, Mann-Whitney U test comparing creeping and crawling gain scores between groups 47

TABLE 7, Mann-Whitney U test comparing motor development gain scores between groups 48

TABLE 8, Analysis of Covariance comparing mean IQ improvement between groups 49,50

TABLE 9, Experimental group motor development pre-test, post-test comparison 105

TABLE 10, Control group motor development pre-test, post-test comparison 105

I Introduction

Recent progress in the behavioral and biological sciences along with the awareness these advances have produced of the complex nature of human developmental and learning deficiencies accentuates two major problems of our society in the Twentieth Century. Stein reports the concern of government officials for these problems:

> President John F. Kennedy, through his council on Youth Fitness, directed to school board members, school administrators, teachers, and to the pupils themselves, '. . . this urgent call to strengthen all programs which contribute to the physical fitness of our youth . . ..' The President charged his Panel on Mental Retardation with '. . . the responsibility . . . to explore the possibilities and pathways to prevent and cure mental retardation. No relevant discipline and no fact that will help achieve this goal is to be neglected.' (53)

Mentally retarded children, while below normal in intellectual functioning, are generally found to be below normal in physical development and in the performance of motor skills. Hebb (29) has indicated that early perceptual and motor experiences of the child are critical and can have, if restricted, a detrimental, or if the environment is non-restrictive, a facilitating effect upon the child's total subsequent physical and intellectual development. Luria has pointed out that:

> . . .sometimes, if a single link of training is missed, if a certain stage in the development of the necessary operation is not properly worked up, the entire process of further development becomes retarded . . .. (42)

Delacato (11), Kephart (36), and Gesell (20) have outlined developmental sequences of perceptual and motor experiences that they say are vital for normal child development. Deviations from what is considered normal child development, then, become possible etiological factors in children who function below normal in physical and intellectual skills.

At present, the precise relationship between psychomotor and cognitive development is obscure. What is clear, however, is the unexplored potential effectiveness of physical activities in remediating and preventing the problems of the mentally retarded. Stein points up the need for research:

> Few contemporary publications have been concerned with the play, physical education, recreation, physical fitness, or motor function of the mentally retarded to the same degree that they have dealt with other aspects of their behavior and function. This has created a scarcity of research in these areas that has limited understanding of, and restricted programing for, retardates. (53)

II Overview

The impetus for the present investigation was a cognizance of the need in special education for a well-structured sequentially planned program of physical education and the function of research in meeting that need.

Motor development programs for the retarded have been neglected. There are many mentally retarded children who receive no instruction in physical education. Most existing programs are not adapted to the needs of the mentally retarded and often consist of nothing more than "free play" activities. An urgent need in physical education for the mentally retarded is for a well-defined rationale and a structured sequence of activities that lends itself to transmission to professionals and modification by them if new knowledge indicates the need for change.

In recognition of this need, the National Education Association's American Association for Health, Physical Education and Recreation (AAHPER) established, in cooperation with the Joseph P. Kennedy Jr. Foundation, a Project on Recreation and Fitness for the Mentally Retarded. From the director of that project, the author received a list of 31 professionals interested in the problem. To each, the author sent a questionnaire asking:

(1) What, if any, is the relationship between the physical development of the mentally retarded and the development of their cognitive skills as measured by academic achievement? How can this relationship, if you believe one exists, be affected by a program of physical education?

- Without exception, they indicated belief in a causal relationship and that a program of physical education could, indeed, enhance cognitive functioning. This is a theoretical position that is not supported by consistent progress through systematic application. It is necessarily a belief based upon hopeful thinking and selective perception as there has not been a thorough scientific analysis of the factors involved.

(2) What are the several distinctly different physical education programs now in use for the mentally retarded? Can a philosophical or empirical rationale for each be delineated?

- Only three existing programs could be identified as having definite goals and objectives. There were numerous programs designed to enhance physical fitness, several aimed at perceptual-motor proficiency (Kephart) and still fewer programs of neurological organization (Doman-Delacato). It was apparent that physical fitness activities could be integrated into either a "neurological organization" or a "perceptual-motor" program. Thus, the questionnaire yielded only two distinct programs of physical activities for the retarded that proposed a theoretical rationale with structured treatment and advantages of behavioral prediction.

The Doman-Delacato and Kephart programs, in addition to being the only physical activity programs for the mentally retarded that could readily be distinguished, have several things in common:

(a) they differ significantly from traditional programs,

(b) they are currently used on a very limited basis,

(c) they have not been accepted by the majority of the professional community,

(d) they present no substantive experimental support,

(e) they assume a causal psychomotor-cognitive relationship, and

(f) they offer the potential of not only meeting the physical education need through physical improvement but also offer remediation of the child's cognitive dysfunction.

The author conducted an empirical investigation of the Doman-Delacato and Kephart theories of treatment. That report specifically recommends:

> Since many of the procedures advocated by both schools are extremely similar, and the most obstrusive difference between the two schools is in rationale (i.e., Kephart has not ordered nor specifically stated his rationale), the present investigators recommend that rigorous experimental designs be developed to test the validity of the Doman-Delacato rationale. (37)

The information gained from the questionnaire and the author's empirical investigation clearly indicate that the Doman-Delacato Theory of Neuropsychology is amenable to research and that it is, indeed, propitious to experimentally investigate a practical application of the Doman-Delacato theoretical position.

SECTION B

RELATED STUDIES

III A Critical Review of Related Literature

Much of the considerable research seeking to relate physical development to cognitive functioning (23, 32, 48, 50) has led to conflicting, inconclusive, and only low positive correlations (2, 48). Descriptive studies have been done showing some relationship between such factors as reading deficiencies and cerebral injury (11, 33), tactile functions and hyperactivity (3), and intelligence and motor proficiency (15, 28, 46, 49). But because of the low reliability and validity of many of the procedures utilized in these studies, Bucher concluded in 1965 that, "More research is needed to establish and define the direct relationship of physical activity, motor skills and health to academic achievement." (7)

For certain handicapped children, the development of motor abilities alone may be prerequisite to the emergence of classroom skills and abilities. It is not necessary to examine the widely separated variables which many investigators have attempted to correlate, say Breckenridge and Vincent:

> . . . control of one's own body means the beginning of self-control in general. In bringing his own body under control the child brings under control the most ever-present piece of his environment. Having controlled the most obvious part of himself, the child finds it easier to bring his temper and other emotions under control. (6)

Perhaps Kephart best summarizes the attitudes of several authorities including Delacato, Gesell, Jersild, and Piaget, when he writes:

> The early motor or muscular responses of the child, which are the earliest behavioral responses of the human organism, represent the beginning of a long

> process of development and learning . . .. To a large extent, so-called higher forms of behavior develop out of and have their roots in motor learning. (36)

Performance of motor skills is dependent upon continuous feedback from the auditory, visual, muscular, and joint senses (20, 25), so perceptual processes are an integral part of any motor activity. Gesell (20) gives additional justification for this assumption when he points out that the course of muscle movements is determined by visual and proprioceptive cues. Delacato, Kephart and Gesell contend that there is no simple distinction between a motor skill and a perceptual skill. According to them, perceptual skills are an essential part of the motor process providing continuous feedback from the muscle to the brain and coordinating appropriate motor responses made by the muscle (2, 11, 20, 34). Kephart expresses this relationship thus:

> . . . a division of thinking is impossible . . . we cannot think of perceptual activities and motor activities as two different items; we must think of the hyphenated term, perceptual-motor. (36)

Gestalt psychology, Freeman's motor-adjustment theory (1) and the more recent Werner and Wapner sensory-tonic field theory (56) have called attention to the reaction of the "whole" organism to specific environmental situations. It follows that if perceptual training augments perceptual ability, then, perceptual, motor, and perceptual-motor training should provide the child with increased perceptual-motor abilities.

Research on the role that experience, or training, has on perceptual ability is at first glance very controversial. However, eliminating the perennial arguments between the nativists and empiricists, whose differences are partly a reflection of the nature-nurture contro-

versy, one finds that fairly definite conclusions have been reached by investigators. Nissen (44) found that restriction of opportunity for tactual, kinesthetic, and manipulative experience of a chimpanzee had a detrimental effect on tactual perceptual processes, indicating that tactual perception does involve learning and is not entirely a result of genetics and maturation. Gibson and Gibson (24) concluded after numerous experiments that repetition or practice is necessary for improved perception. Hilgard (30) gives reliable evidence that experience with various stimuli increases the ability to deal with these stimuli in new situations. Robert L. Frantz (19) after experimenting with chimps, chicks, and infant children concluded that perception was improved through training. His findings also support the idea that physiological maturation and innate potential interact with this training in the development sequence.

Various investigators have compared the motor performance of the mentally retarded with that of normal children. Most of the research done in this area has been descriptive and has not included rigorous experimental design. Clifford Howe, (31) in a comparison of retarded and normal groups of 43 children each, found that the normal children were consistently superior to the mentally retarded on a variety of motor skills. Brace (5), Francis and Rarick (18), Thurstone (54), Malpass (43), and Langan (39) compared the motor characteristics of mentally retarded children with those of normal children and found that the retarded children were consistently deficient in motor skills. However, Langan (39) concludes that further research is needed to determine the effects of a systematic motor training program on the educable mentally retarded.

suggesting that retardates can improve their motor skills and perhaps, through training, may become as proficient as normal children. Brace, (4) in a later study, investigated the physical fitness of a group of institutionalized mentally retarded boys relative to national age scales. He found that on the AAHPER Youth Fitness Test 80.6% of the scores for the retarded fell below the median of the national scales. Stein replicated Brace's study using mentally retarded boys enrolled in special classes in a public school system who participated in daily classes of physical education. The results obtained by Stein were compared to Brace's data and found to conflict. Stein posits the difference thus:

> It is interesting to note that exactly half of the 24 comparisons resulted in distributions in which better than 50 percent of the retarded subjects surpassed the national mean . . . it points to differences that were brought about through lack of experience and opportunity of the institutionalized retardate to participate in activities of a physical nature involving gross bodily movement. (52)

Hayden (27), Howe (31), and Stein (51) have shown that the retarded do have the capacity to develop physical skills on a level with nonretarded individuals. Llorens, (41) in a report on motor training given emotionally disturbed children in six functions including fine motor control, reported favorable results. The motor training was so broadly structured, however, that it could not be defined. That the perceptual-motor abilities of the mentally retarded child usually fall below those of the normal child is evidently due to acquisition rather than inherent defect. In the light of recent evidence it is credible that a nonrestrictive environment offering a maximum opportunity for proper stimulation and movement can remediate physical subnormalities and deficits of mentally retarded children. But the etiology of perceptual-motor dysfunctions in

the mentally retarded child is difficult to define, hence, symptomatic diagnoses that attempt to prescribe correct programs of activities endemic to each child's individual needs are, at best, tenuous. The results of recent publications indicate, however, that the cause of failure in perceptual-motor function may be developmental (12, 20, 34, 36).

Recognition has been given to the fact that perceptual-motor skills do go through a developmental sequence (20,36). Gesell, (20) through his empirical investigations, has concluded that the organization of movement is based on an integration and stabilization of basic behavior patterns which are fundamental to the development of more advanced activities. Delacato, Kephart and Gesell contend that a pretermitted stage of the developmental sequence results in failure to adequately attain higher stages (11, 20, 36). Some interference with a particular stage of perceptual-motor development thus becomes a possible etiological factor of poor motor performance in the mentally retarded. Cruickshank, (10) in describing brain injured children whose motor development has been delayed, observes that those children who lack physical control exhibit striking patterns of misbehavior and display wide gaps in their developmental patterns.

The evidence available at this time supports the idea that perceptual training does lead to improved perceptual ability. From the interrelatedness of perceptual and motor processes, it follows that perceptual-motor training should enhance perceptual-motor ability. A crucial question is whether training is generalizable, e.g., whether training on a particular perceptual-motor task improves perceptual-motor performance on other tasks that have not been practiced. Further, Delacato and Kephart have identified normal developmental sequences (Delacato's differs from

Kephart's *) of perceptual-motor activities that supposedly play a vital role in the total physical and intellectual development of every child. Delacato has explicated these experiences in his treatment rationale for children with neurological dysfunction, the scope of which includes the vast majority of children now considered mentally retarded (11, 12, 13).

Empirical evidence to support the idea that perceptual-motor training leads to perceptual-motor improvement has been scant (9, 31, 40, 45). Some literature (9, 11, 12, 13, 21, 22, 34, 35, 36, 45) holds abundant testimony concerning the high relationship between perceptual-motor training and school achievement, and/or IQ; but this testimony, with questionable evidence, is of little practical use to the conscientious educator. Delacato (11, 12, 13) and Kephart (34, 35, 36) make inferences, without experimental support, that connect motor functions to cognitive competencies and the critic uses this as ammunition against the whole field of perceptual-motor training that has improvement in perceptual and/or motor functioning per se as its objective. Sound experimental evidence is needed to either support or refute the contention that perceptual-motor training through participation in a structured program of physical activities does indeed improve the perceptual-motor and/or cognitive competencies of the mentally retarded child.

---

*For a detailed discussion refer to the author's critical analysis of the two positions (37).

IV Background of Experimental Research on Physical Education Programs for the Mentally Retarded

To date, only three studies (9, 45, *) have attempted to assess the effects of a program of physical activities on the development of mentally retarded children; these studies were conducted with educable retarded children. The present investigation is the first experimental effort designed to determine the effects of a physical activity program on trainable mentally retarded children.

Oliver (45) in 1958 advanced the idea that certain intellectual and physical characteristics of educable mentally retarded boys could be enhanced through participation in a planned program of physical education activities. Although Oliver found statistically significant gains after ten weeks in both physical proficiency and intelligence test scores favoring the experimental group, the investigation was conducted in an institutional setting and did not control for the Hawthorne Effect.

Corder (9) undertook what was essentially a replication of the Oliver Study with the addition of a "Hawthorne" group. Working with educable mentally retarded boys in special classes, Corder found significant differences in favor of the experimental group on IQ gain scores using the Wichsler Intelligence Scale for Children (WISC) and on all tests of the American Association of Health, Physical Education, and Recreation (AAHPER) Youth Fitness Test. Corder is presently involved in a study to determine if the gains have been maintained over time and if the IQ gains were accompanied by improvement in academic achievement.

---

*in correspondence with the author

On the other hand, Pangle and Solomon (George Peabody College, Nashville, Tennessee) followed Corder's study with another. They used the following criteria:

(1) test of intelligence - Binet

(2) test of physical fitness - AAHPER

(3) test of academic achievement - Gates

The results of the study have not yet been published. However, Pangle and Solomon report*: (1) that physical fitness performance in educable mentally retarded boys was improved as a result of an eight week structured program of physical education, (2) IQ was not improved significantly, casting some doubt on the findings of the Oliver and Corder experiments.

In a recent doctoral dissertation in reference to the Oliver and Corder studies Lillie (40) says,

> It is also questionable whether the training tasks should be used as the criterion variable. In effect, this constitutes teaching for the test. Significant improvement is not surprising when the treatment and the dependent variable involve the same tasks.

A review of experimental research on physical education programs for the mentally retarded thus indicates the following:

(a) the affects upon cognitive functioning are inconclusive,

(b) physical fitness as measured by tests of stamina and indurance can be increased; however, when this has occurred the independent and dependent variables have been the same, and

(c) the experimental treatments have not been well defined nor a rationale presented.

---

*in correspondence with the author

It may be that one's obligation extends beyond merely outlining techniques for perceptual-motor training without providing a scientifically based theory underlying these techniques. Possibly it is important to know <u>why</u> one is doing something which seems to improve classroom behavior.

Kirk summarized the research related to the effects of physical education on the motor abilities of the mentally retarded as follows:

> Surveys on motor proficiency show quite clearly that retarded children are inferior to normal children in this so-called nonintellectual ability. The effects of training in physical education have not yet been determined. In view of Seguin's earlier efforts with the physiological method of training defectives and sporadic attempts to use physical activities as an educational media, research in this area has been seriously neglected. With the recent interest in the concepts of Piaget and the methods of Montessori, a fresh approach to this question should be in the making. (38)

Research to date attempting to relate the effects of physical education on trainable mentally retarded children, with whom the present study is concerned, is essentially non-existent. The status of the more severely involved mentally retarded is summarized by Kirk:

> The question of the improvement of trainable mentally retarded children through classroom training programs is still a major problem. Attempts at research with this group have netted relatively negative results. . . . it might be necessary to find new approaches to the educational programs for these children. (38)

V Background of the Theory of Neuropsychology

Experimental research investigating hypotheses deduced from the Doman-Delacato Theory of Neuropsychology is scant. Doman et al. (14) presented a descriptive study of the procedures in application with children exhibiting severe brain injury. The few experimental studies available (12, 47) present conflicting evidence and are concerned with the relationship of language disorders to Neurological Organization in minimally involved children rather than mobility and communication disorders with mentally retarded children.

The central concept of the Doman-Delacato Theory of Neuropsychology is Neurological Organization (11, 12, 13). Neurological Organization assumes that ontogeny (the process of individual development) recapitulates phylogeny (the process of species development). This development proceeds in an orderly, anatomical way through the cord and medulla, pons, midbrain and cortex, and culminates in cortical hemispheric dominance. Neurological Organization defined by Delacato:

> . . . that physiologically optimal condition which exists uniquely and most completely in man and is the result of a total uninterrupted ontogenetic neural development. This orderly development progresses vertically through the spinal cord and all other areas of the Central Nervous System up to the level of the cortex as it does with all mammals. Man's final and unique developmental progression takes place at the level of the cortex and is lateral. This progression is an interdependent continuum hence if a high level of development is unfunctioning or incomplete . . . lower levels become operative and dominant . . .. If a lower level is incomplete, all succeeding higher levels are affected both in relation to their height in the Central Nervous System and in relation to the chronology of their development . . .. In the totally developed man, the left or right cortical hemisphere must become dominant, with lower prerequisite requirements met, if his organization is to be complete . . .. If man does not follow this schema he exhibits problems of mobility or communication. (11)

According to this rationale, the individual's development of mobility, manual competence, language; vision, audition, and tactile competence, parallels and is functionally related to his anatomical progress.

It has been further reasoned that levels of performance in mobility, manual competence, language; vision, audition, and tactile competence, are indicative of the degree of Neurological Organization. By measuring the level of competence in these areas, one obtains a measure of Neurological Organization. If the individual has either skipped or prematurely terminated a developmental phase, his performance is below normal.* For remediation of difficulties, Doman and Delacato prescribe a recapitulation of the developmental sequence from the lowest level at which performance is poor to the highest level (cortical hemispheric dominance).

Furthermore, one of the important causes of mental retardation is impairment to the nervous system, especially the brain. Proponents of the Neuropsychological approach believe that it is possible to restore functions of the brain that have been destroyed or that have never properly developed by subjecting the child to a treatment program designed to achieve proper neurological functioning. It is their contention that learning disabilities of an organic causation have their origin in the brain, therefore, efforts to help overcome the learning deficit should be directed toward the brain. They believe that the brain impairment may result from (a) brain injuries or (b) factors that interfere

---

*In minimally involved individuals manifest performance is below potential performance, not necessarily below normal.

with orderly neurologic development. Treatment is based on the assumption that experience affects the brain and that specific types of experience will affect specific levels of the brain (12).

According to this approach, neurological development is directly related to psychomotor development. It follows that mentally retarded children participating in a program of physical activities consistent with the Theory of Neuropsychology and aimed at enhancing Neurological Organization through a recapitulation of phylogenetically based ontogenetic experiences should achieve corresponding increases in physical and cognitive proficiency.

VI A Preliminary Pilot Investigation

A pilot project (unpublished) was conducted by the author and David Bauer at the Ebensburg State School and Hospital. The study was designed to test one basic aspect of the evaluative and treatment procedures integral to the Doman-Delacato Theory of Neurological Organization.

Two of the fundamental stages of the mobility continuum, crawling and creeping, were chosen as the dependent variables investigated in this study which dealt with institutionalized trainable mentally retarded children. Two groups of six children each were randomly selected and randomly assigned as either experimentals or controls. The experimental treatment consisted of creeping and crawling two hours a day for a four-week period.

Analysis of the results support the very basic assumption of Doman-Delacato treatment, i.e., institutionalized mentally retarded children who practice creeping and crawling improve in their creeping and crawling performance. The data also support the general position of Kephart, i.e., that gross-motor and fine-motor coordination (creeping and crawling) can be improved through a program of perceptual-motor training (creeping and crawling).

SECTION C

METHOD

VII Statement of Purpose

The purpose of this investigation was twofold:

(1) To determine the effects of a structured program of physical activities consistent with the Neuropsychological Theory on the physical and intellectual development of trainable mentally retarded children.

(2) To assess the Theory of Neurological Organization through application in a public school setting with trainable mentally retarded children.

Specific dimensions included in the study were: gross-motor and fine-motor coordination (as measured by a mobility scale derived from the Doman-Delacato Developmental Profile), physical proficiency and perceptual-motor development (as measured by the Kershner-Dusewicz-Kershner revision of the Vineland adaptation of the Oserstsky Tests of Motor Development), cognitive functioning (as measured by the Peabody Picture Vocabulary Test).

VIII Procedure

Location: The study was conducted in two schools of the Northern Lehigh School District, Lehigh County, Pennsylvania.

Sample: The children selected for this investigation were boys and girls enrolled in Lehigh County operated public school special education classes for trainable mentally retarded children. The children represent a similar background and socio-economic level. Two intact classes were used with a teacher and teacher aid randomly assigned to each class. The principal investigator was not concerned with the criteria used by the Lehigh County Schools in assigning these children to a trainable classification, nor was the author concerned with etiology of dysfunction. Currently, these are the kinds of children found in classes for trainables and precision diagnosis of etiology remains a technological problem. These are two independent samples of trainable mentally retarded children representing a group for whom contemporary methods of treatment have failed. Discretion is needed in pointing out any single criterion in the groups for comparison. Connor aptly comments:

> The survey confirms the impression that this is generally a multiply handicapped group (trainable retarded). The high percentage of children manifesting IQs above 50 (particularly in public day school classes) indicates that factors other than intellectual ability are considered in placement. (8)

The experimental and control treatments were also randomly assigned to the intact classes. CAs ranged from 8 to 18 in the experimental and 8 to 17 in the control. Individual absences of 15 or more was considered justification for elimin-

ation of that child from the study. The experimental group consisted of 7 males, 6 females; the control group consisted of 10 males, 6 females.

Table 1 The number of subjects in each group

Item	Control group	Experimental group	Total sample
November 1, 1966	16	14	30
Students eliminated:			
Excessive absences	0	1*	1*
Other reasons	0	0	0
February 28, 1967	16	13	29

*18 absences

Teacher Orientation: The teacher assigned to the experimental group participated in a seven-day Intensive Orientation Course at the Institutes for the Achievement of Human Potential in Philadelphia, Pennsylvania. It needs to be emphasized that a traditional control group was not employed. In this experiment an experimental program of rhythmical balance and coordination activities was designed for the "control" group. The teacher of the "control" group was impressed with the importance and innovative character of her experimental program. This was the principal investigator's attempt to equalize teacher enthusiasm and pupil reaction to their respective programs. In addition, the results should be more meaningful with the experimental group being compared to a group also

engaged in a rigorous physical education program rather than being compared to an inactive control group.

Medical Supervision: The children in the control group were given the medical care normally required. The experimental group children, in addition to being under the medical supervision normally rendered by school physician Harry Kern, M.D., were administered eye acuity examinations both preceding and following the study by Mrs. Ann Lengel, R.N., Elementary School Nurse. Specific recommendations for eye occlusion and all other aspects of the experimental program dealing with visual perceptual training wereunder the supervision of Dr. Clairmont Kressley, M.D.

Pre-testing: Pre-testing began October 10, 1966 and was terminated October 28, 1966. The testers alternated daily between the two schools. They chose subjects randomly and generally maintained an equal ratio of "children tested to children yet to be tested" between the two groups. IQ and creeping and crawling evaluations were administered in the morning, 9:30 to 10:30, and the motor development test was administered in the afternoon.

Post-testing: Post-testing began March 1, 1967 and was terminated March 17, 1967. The testers alternated daily between the two schools. They chose subjects randomly and generally maintained an equal ratio of "children tested to children yet to be tested" between the two groups. IQ and creeping and crawling evaluations were in the morning, 9:30 to 10:30, and the motor development test was administered in the afternoon.

Criteria Measures: Pre- and post-test data in the experimental group and control group were obtained by two research evaluators, Department of Public Instruction, Commonwealth of Pennsylvania. The same testers were used in both testing periods and an examiner did not know the treatment group to which a subject belonged. Both testers received instruction at the Institutes for the Achievement of Human Potential in Philadelphia, Pennsylvania. This included orientation to the procedures and rationale of the Doman-Delacato program and training in creeping and crawling evaluation. The testers also participated in a one-week familiarization program supervised by the author to insure standard administration and evaluation with all testing instruments.

1. A test of mobility adapted from the Doman-Delacato Developmental Profile was administered. Both testers evaluated each child at the same time after an inter-rater reliability of 0.98 was achieved prior to pre-testing. The coefficient of stability of the original mobility segment of the Developmental Profile which is retained in expanded form in this adaptation is computed at .93 by Raymond Taylor, Director of the Research Institute, Institutes for the Achievement of Human Potential, Philadelphia, Pennsylvania. The adapted scale utilizes, in addition to those stages identified by Gesell, the more refined, natural, phylogenetic-ontogenetic movements identified by Doman and Delacato. The adapted scale with the omission of item 11 (C), was developed by Dr. Robert Doman, Medical Director of the Institutes for the Achievement of Human Potential, Phila-

delphia, Pennsylvania, and Mr. John Unruh, Institutes for the Relief of Brain Injuries, Media, Pennsylvania, for utilization in the evaluation and treatment of children by United Cerebral Palsy of Delaware County, Chester, Pennsylvania. The scale is also being utilized by Ridley Township Schools, Folsom, Pennsylvania, in their Special Education Program. The author included item 11 (C) in the present adapted scale because of the emphasis given this item by several qualified evaluators at the Institutes. The scale is a measure of gross perceptual-motor and fine perceptual-motor performance. Such a measure tests the very basic assumption that creeping and crawling performance improves through participation in a program of activities (that includes creeping and crawling) consistent with the Theory of Neurological Organization. If Neurological Organization is enhanced through participation in the program of activities, concomitant improvement along the mobility continuum, as measured by creeping and crawling performance, should occur. Delacato (11) claims that, "we can corroborate the progress of neurological organization clinically. The mobility functions of growing and maturing children indicate the level of neurological organization they have reached."

2. The Kershner-Dusewicz-Kershner Revision of the Vineland Adaptation of the Oseretsky Tests of Motor Proficiency was administered. A review of the available tests of motor skill and motor maturity revealed that, among the few similar existing tests, none approach the Oseretsky Tests of Motor Proficiency in providing for the assessment of a great variety of skills and levels of performance.

The Lincoln-Oseretsky Motor Development Scale was deemed inappropriate for the kinds of children in the present study. The Vanguard School, a private school for educationally inadequate children in suburban Philadelphia, in an unpublished report, indicate that the "Lincoln-Oseretsky provides little usable information." Seventy-one percent of the children tested (children exhibiting perceptual-motor disorders) scored below the 10th percentile and eighty-seven percent fell below the 50th percentile. Because the Lincoln adaptation apparently is insensitive to extreme deviations from the norm, the scale is inappropriate as a useful measure of perceptual-motor development when administered to children more severely involved. Therefore, despite the obvious problems inherent in dealing with a totally unstandardized and unrefined instrument, the Vineland-Oseretsky was chosen for the present investigation. The present modifications of the Vineland-Oseretsky include:

(1) for facility and less expensive administration the list of required equipment has been altered, including deletions, additions and revisions,

(2) group administration for practicality, to lessen the children's anxiety and to obtain a more valid measure,

(3) instructions clarified to counter ambiguity,

(4) cut-off points arbitrarily chosen for items yielding a numerical score or score in seconds to make the scale sensitive to the abilities of the children tested,

(5) deletion of Speed IX, X, XII, XVI, XIV, and S.V.M. IX because double standards for scoring these items requires an accumulation of normative data not yet available.

Subtests are:

(1) General Static Coordination

(2) General Dynamic Coordination

(3) Dynamic Manual Coordination

(4) Speed

(5) Simultaneous Voluntary Movement

The laterality items on the Oseretsky provided information on the preferred sidedness of the children. Knowledge as to the preferred side of each child was crucial to the individual program prescribed for each child in the experimental group. The Oseretsky Tests examined an explicit contention of the Neuropsychological Theory of treatment, i.e., that recapitulation of early perceptual-motor developmental sequences is prerequisite to and improves the performance of more sophisticated perceptual-motor skills that are not practiced. The effects of a structured program of physical education consistent with the Theory of Neurological Organization on the perceptual-motor proficiency of trainable mentally retarded children will also be ascertained.

3. The Peabody Picture Vocabulary Test of intellectual functioning was administered. Form B was administered for the pre-test and Form A for the post-test. The PPVT is designed to provide a well-standardized estimate of a subject's verbal intelligence through measuring his hearing vocabulary. On mentally retarded and cerebral palsied subjects, age equivalent scores on the PPVT and the Revised Stanford-Binet Tests of Intelligence were correlated. For 315 "educable" children ages 6 to 18 years,

the validity coefficient was 0.76 (16). For 220 "trainable" children, ages 6 to 16, a coefficient calculated in the same manner was 0.66 (17). In a recent comparative study data were collected on a nationwide sample of 386 mentally subnormal boys and girls. Results indicated that the two cognitive instruments studied, the Peabody Picture Vocabulary Test and Revised Stanford Binet, were equivalent for trainable mentally retarded children (26). Such a measure:

(1) tested for the effects of a physical education program consistent with the Theory of Neurological Organization on the intelligence of trainable mentally retarded children, and

(2) served as a check for the pseudo-improvement in Neurological Organization possible in the experimental group on the first criterion measure. The author stated in a previous report:

> . . . regardless of the site of injury conscious adherence to the instructed movement patterns cannot be considered as indicative of a remediation of the child's dysfunction. This presents a problem when evaluating; i.e., the evaluator must be able to detect the pseudo-improvement manifest when the child is consciously following instructions. Only if the movements are natural can they be considered a recapitulation of ontogenetic development and an indication that the injured area has been affected. (37)

In the present investigation every attempt is made to structure the mobility procedures via verbal instruction and initiation. Inasmuch as this is possible in light of the severe involvement of the children in this study pseudo-improvement in mobility, which is an index of Neu-

rological Organization, is possible. If Neurological Organization is indeed enhanced, if the child's dysfunction is indeed remediated via the Doman-Delacato program of activities and in accordance with the Doman-Delacato neurophysiological model, then improvement in psychomotor functioning must be accompanied by improvement in cognitive functioning.

IX Pre-treatment Analysis

Table 2 Pre-test scores

Item	Age in Months	Years in Special Education	Absences in Percent	IQ	Creeping and Crawling	Motor Development
Experimental (N=13)						
$\bar{X}$	150.31	4.15	5.15	39.77	51.64	14.51
S.S.	19,800.70	119.69	422.69	7,717.00	6,022.80	1,233.89
s^2	1,650.06	9.97	35.19	643.08	501.90	102.82
s	40.62	3.16	5.93	25.36	22.40	10.14
Control (N=16)						
$\bar{X}$	151.19	3.31	5.19	61.94	43.53	9.78
S.S.	20,536.44	37.44	430.94	6,038.94	2,625.06	552.83
s^2	1,369.10	2.50	28.73	402.60	175.00	36.85
s	37.00	1.58	5.36	20.07	13.23	6.07

Table 3 t analysis of
pre-treatment scores for the two groups

Item	Age in Months	Years in Special Education	Absences	IQ
t ratio	.0603	.8743	.0188	2.57*
probability	>.9	<.4	>.9	<.02

Note: There are 27 degrees of freedom. Differences between groups on pre-test IQ scores are statistically significant. None of the other pre-test mean scores analyzed by the t ratio were significant.

*Statistically significant (.05)

The non-parametric Mann-Whitney U test was chosen to analyze data derived from the Creeping and Crawling Scale and the Kershner-Dusewicz-Kershner Revision of the Vineland Oseretsky Tests of Motor Development. This was decided upon in view of the variances obtained between groups on these measures, because they are measurements from unstandardized tests which are probably at most ordinal scales and in the light of the fact that the study employs two independent small samples.

Table 4 Mann-Whitney U
analysis of pre-treatment scores for the two groups

Item	Creeping and Crawling	Motor Development
Experimental n_1	13	13
Control n_2	16	16
Experimental R_1	232.5	220
Control R_2	202.5	215
U value	66.5	79

Note: Differences between groups on pre-test creeping and crawling and motor development scores are not statistically significant.

*For a two-tailed test a critical U value of $\leq$ 59 is statistically significant (.05)

The groups were statistically similar in regard to age, time in special education classes, absences for the duration of the project, creeping and crawling score and motor development score, but they differed statistically in IQ score.

Although random techniques could not be employed to select or assign subjects to groups, the groups appeared reasonably matched.

X Questions and Hypotheses

Question I:

Does a program of specialized physical activities that is consistent with the Doman-Delacato Theory of Neurological Organization contribute to the creeping and crawling ability of trainable mentally retarded children?

Null Hypothesis I: H_0

There is no significant difference in creeping and crawling improvement between the experimental and control groups. H_1: there is a significant improvement in creeping and crawling performance favoring the experimental group.

Instrument: Creeping and Crawling Scale adapted from the Doman-Delacato Developmental Profile.*

Question II:

Does a program of specialized physical activities that is consistent with the Doman-Delacato Theory of Neurological Organization contribute to the perceptual-motor proficiency of trainable mentally retarded children?

Null Hypothesis II: H_0

There is no significant difference in perceptual-motor proficiency improvement between the experimental and control groups. H_1: there is a significant improvement in perceptual-motor proficiency favoring the experimental group.

Instrument: Kershner-Dusewicz-Kershner Revision of the Vineland Oseretsky Tests of Motor Development.**

---

*Refer to Appendix A

**Refer to Appendix B

Question III:

Does a program of specialized physical activities that is consistent with the Doman-Delacato Theory of Neurological Organization contribute to the measurable functional intelligence of trainable mentally retarded children?

Null Hypothesis III: H_o

There is no significant difference in mean IQ improvement between the experimental and control groups. H_1: there is a significant mean IQ improvement favoring the experimental group.

Instrument: Peabody Picture Vocabulary Test.

XI Program

The program was in effect Mondays through Fridays, November 1 to February 28, 1967. The program extended for seventy-four consecutive teaching days.

A. Experimental Group Activities

Treatment is based on the assumption that experience affects the brain and that specific types of experience will affect specific levels of the brain (11). The activities are sequentially structured according to neurological stages of development. Each stage has qualitative levels that allow each child to perform at his own functional level. Hence, the activities designed to develop a particular neurological stage are group activities, but each child is on an individual program of treatment dictated by his particular competency at each stage. Each child is taught, individually, to master his functional level before going on to the next higher level. If applicable, in parentheses after each activity is the primary brain level receiving stimulation from that activity and responsible for the proper execution of that activity.

1. Homolateral Coordination, (pons) 5 minutes per day;
    a. The child practices homolateral crawling in place. This is done by having him lie down on his abdomen on a smooth surface, changing alternately from left to right sleep positions. When he masters the idea that the left arm and leg are flexed when the right arm and leg are extended, he is taught to reverse the process.
    b. He is then taught to alternate these motions as smoothly and as rhythmically as possible.

c. When this is done the child is taught to look at the hand that comes up at each turn. When his left hand is up he looks at it, then when the right hand is up, he looks at it. This activity is advanced to Cross-Pattern Coordination (midbrain) on an individual basis after each child sufficiently performs the Homolateral Coordination exercise. The activity remains the same except the child alternates limbs in a cross-pattern manner.

2. Unilateral Sleep Pattern Reinforcement, (pons) during daily rest periods of 45 minutes per day;

a. The right-sided child (sidedness is determined by the Oseretsky laterality items) is encouraged to sleep on the stomach, with the left elbow flexed, so that the left thumb is in a thumb-sucking position. The left knee is flexed and the right arm extended with palm up alongside the body. The right leg is extended.

b. The left-sided child is encouraged to sleep on the stomach, with the right elbow flexed so that the right thumb is in the thumbsucking position. The right knee is flexed and the left arm is extended with palm up alongside the body. The left leg is extended.

3. Monocular Visual Pursuit, (pons) one minute with each eye daily:

a. The left eye is occluded. The child holds a target in the right hand and follows it with the uncovered eye. The child is taught to make a circle, square, diagonal to the square and a triangle.

b. The right eye is occluded. The child holds a target in the

left hand and follows it with the uncovered eye. The child is taught to make a circle, square, diagonal to the square and a triangle.

4. Cross-Pattern Crawl, (midbrain) 10 minutes per day:
   The child performs the cross-pattern crawl with the body in contact with the floor. Emphasis is on gross-motor and fine-motor coordination. The child is taught the Doman-Delacato refinements of the gross movement patterns identified by Gesell. The movement patterns are rigidly structured after the child has had sufficient time to reach his own functional level.
5. Binocular Visual Pursuit, (midbrain) one minute per day:
   a. The child holds the target in the hand with which he writes and moves the target in all directions at arm's length following it with both eyes. The head is not moved.
   b. When eye movement becomes smooth the child periodically brings the target close to his nose following with both eyes.
6. Cross-Pattern Creep, (midbrain) 15 minutes per day:
   The child performs the cross-pattern creep on hands and knees. Creeping is well structured after the child has reached his functional level.
7. Binocular Visual Pursuit, (cortical) one minute per day:
   a. The child follows a target in space with both eyes that is not held in his own hand.
   b. As he improves in this he is taught to place objects visually in place on verbal command.
8. Cross-Pattern Walk, (cortical) five minutes per day:

a. Child is taught to walk an exaggerated cross-pattern, moving slowly and pointing to the forward foot with the opposite hand.

b. When this is done smoothly he is taught to look at the forward hand consistently, sighting the forward foot.

9. Auditory Stimulation, and Discrimination for duration of program: Music and tonality are deleted from the child's school environment. Classroom conversation and storybook reading by the teacher and classroom television viewing emphasize extremes of duration, pitch and intensity of sounds. Simulated environmental noises are discriminated, i.e., water running, striking a variety of classroom materials with a rod, etc.

10. Tactual Stimulation, 15 minutes per day:
In addition to the tactual stimulation the child receives in the mobility exercises, tactile perceptual training is given by teaching the child to discriminate a variety of materials via touch. Olfactory and Gustatory discrimination experiences are included.

11. Kicking with the Dominant Foot, 10 minutes per day:
The child engages in games and is taught to kick with the dominant foot.

12. Throw with the Dominant Hand, 10 minutes per day:
The child engages in games and is taught to throw overhand with the dominant hand.

13. Cortical Hemispheric Dominance, Far Point, 15 minutes per day:
The child follows the teacher who is at the blackboard presenting material that is irrelevant to the exercise but consistent

with the program. The nondominant eye is occluded.

14. Cortical Hemispheric Dominance, Near Point, 15 minutes per day:
The child engages in play with building blocks, form boards, etc. The nondominant eye is occluded.

15. Bilateral Reinforcement, 20 minutes per day:
The child participates in games and is taught to kick with both feet simultaneously and alternately and to throw with both hands simultaneously and alternately. Competence in this is prerequisite for engagements in activities 11 and 12.

The entire school curriculum, five and one-half hours per day for the experimental group, involved activities consistent with the Doman-Delacato Theory of Neurological Organization. The more strenuous activities were conducted in a multipurpose room especially adapted for those activities for one hour each day. The remaining activities took place in the classroom.

I. Equipment: (related exercise designated by number(s) following material)

(1) two 12' x 15' nylon pile rugs (1), (4), (6).

(2) fourteen soft plastic eyepatches (3), (13), (14).

(3) three basketballs (11), (15).

(4) fourteen bright colored handballs (12), (15).

(5) two plastic bowling sets (11), (12).

(6) two paper wall targets (11), (12), (15).

(7) television set (9), (13).

(8) fourteen pencils with bright red 1" dia. balls glued on top (3), (5).

(9) fourteen blankets (2).

(10) three pursuit posterboards 3" x 4" with figures outlined in bright red - a circle, square and diagonal (J).

(11) thirty feet of 1" red tape (B).

(12) fourteen bracelets and fourteen anklets (11), (12).

(13) harmless materials that have a distinctive feel, smell, or taste (10), i.e., sandpaper, orange, salt, etc.

II. Daily Schedule:

A.M. 9:00 to 9:15

Cortical Hemispheric Dominance, Near Point

9:15 to 9:30

Cortical Hemispheric Dominance, Far Point

Auditory Discrimination

9:30 to 9:40

(changing to go to multipurpose room)

9:40 to 10:40

Homolateral Coordination

Cross-Pattern Coordination

Cross-Pattern Crawl

Cross-Pattern Creep

Tactual Stimulation

Bilateral Reinforcement

Kicking with Dominant Foot

Throwing with Dominant Hand

10:40 to 11:10

(change clothes, snack, bathroom)

11:10 to 11:20

Monocular Visual Pursuit

Binocular Visual Pursuit (unilateral and vertical)

11:00 to 11:30

Tactual Stimulation and Discrimination

Auditory Stimulation and Discrimination

11:30 to 12:00

(prepare for lunch)

P.M. 12:00 to 12:45

(lunch)

12:45 to 1:30

Unilateral Sling Pattern Reinforcement

1:30 to 2:30

Bilateral and Unilateral Group Activities

Cross-Pattern Walk

B. Control Group Activities

The entire school curriculum, five and one-half hours per day for the control group, involved nonspecific activities. The games and activities were constructed to give reason for the teacher to direct individual and group praise and encouragement. The children were given attention approximately equal to that received by the experimental group. This is the author's attempt to control for the Hawthorne Effect. For the thirty minutes that the experimental group was visually occluded on the nondominant side, the control group wore the same type eye-occluder in a nonspecific manner on the back of their heads. This was done to compensate for any possible effect the mere ownership of an eyepatch may have had on the children in the experimental group. The more strenuous activities were conducted in

a multipurpose room especially adapted for those activities for one hour each day. The remaining activities transpired in the classroom.

I. Equipment: no special equipment was required.

II. Daily Schedule:

A.M. 9:00 to 9:15

table play, i.e., building blocks, etc.

9:15 to 9:30

show and tell

9:30 to 9:40

(changing to go to multipurpose room)

9:40 to 10:40

marching in place, swinging arms

follow the leader to music

carrying rhythm sticks as flags, etc.

"freezing" or "squatting" as music stops

rolling and catching ball

dodge ball

hopping, jumping, galloping, skipping

walking like a duck, elephant, etc.

fly like a moth, to records

10:40 to 11:10

(change clothes, snack, bathroom)

11:10 to 11:20

writing numbers and alphabet to music

11:20 to 11:30

(prepare for lunch)

11:30 to 12:30

(lunch)

12:30 to 1:30

rest period, to music

1:30 to 2:30

movies

group singing and dancing games, i.e.,

Rig-a-jig-jig, Looby-do, Mexican Hat Dance,

Duke of York, Farmer in the Dell, Mulberry

Bush, London Bridge, Did You Ever See a Lassie?,

musical chairs, rhythm band

422 Supervision

The author visited the experimental and control groups weekly to insure adherence to both programs as prescribed.

The experimental and "control" programs were conducted by the staffs of the respective schools.

XIII Limitations

Design - In that the experiment, by design, was applied rather than pure or basic research, restrictions are imposed upon attempts to derive valid inferences concerning the Doman-Delacato Theory of Neurological Organization in contexts differing from the one reported. More important than the validity of the theory per se is its assessment through practical application in a variety of educational settings.

Sample - Neither a random sampling of the population nor randomized assignment of children to the experimental and control groups was possible. The extent to which the results can be generalized and to whom they can be generalized is, therefore, affected to an unknown degree. No biases were intentionally introduced by the principal investigator.

Because the more severely involved mentally retarded, the trainable, is considered non-educable and "hopelessly" afflicted and because so little has been done at the lower levels of retardation the author chose trainable mentally retarded children for the present study. This is a limitation on the efficacy of the procedures being investigated but will also make the results more significant should the experimental group react favorably to the experimental treatment.

Instruments - Conclusions derived from the measures taken on any or all three of the dependent variables are necessarily limited by the measuring instruments themselves especially in view of the fact that only one (PPVT) has been standardized or validated to any extent.

Procedures - The experimental procedures were designed to test a theory of treatment for mentally retarded children that differs significantly from traditional and contemporary approaches. In addition to claiming a here-to-for unimaginable potential for mentally retarded children the treatment under investigation has as its objective the total physical and intellectual development of retarded children. The author is not concerned with the theory per se but with its practical applicability and its potential utilization in a public school setting. For these reasons the procedures were implemented on a five-day-a-week basis during normal school hours and without parental aid or supervision. The program purposely extended through the Thanksgiving and Christmas holidays.

Time - The results are affected to an unknown degree by the brevity of the program which extended for a four-month period.

SECTION 3

FINDINGS

XIV Final Analysis and Results

Each of the three hypotheses was tested in the null form to determine whether differences between groups on each criterion variable could be explained by chance. Alternate hypotheses favoring the experimental group were formulated for each null hypothesis. A relationship was considered sufficient to reject the null hypothesis if the obtained level of significance was at least .05.

The three hypotheses utilized data based on both pre- and post-test information.

Table 5 Post-test scores

Item	IQ	Creeping and Crawling	Motor Development
Experimental (N=13)			
$\bar{X}$	51.77	84.74	25.78
S.S.	5,704.31	2,479.06	2,190.62
s^2	475.36	206.59	182.55
s	21.80	14.37	13.51
Control (N=16)			
$\bar{X}$	58.56	44.94	20.26
S.S.	5,504.06	2,161.33	1,310.27
s^2	366.94	144.09	87.35
s	19.16	12.00	9.35

Hypothesis 1

H_0: There is no significant difference in creeping and crawling improvement between the experimental and control groups.

H_1: There is a significant improvement in creeping and crawling performance favoring the experimental group.

Analysis The Mann-Whitney U test was employed in a comparison of pre- post-test gain scores between groups.

Table 6 Mann-Whitney U test
comparing creeping and crawling gain scores between groups

Item	Creeping and Crawling
Experimental n_1	13
Control n_2	16
Experimental R_1	271
Control R_2	164
U value	28*

Note: Differences between groups on pre- post-test creeping and crawling gain scores are statistically significant. The direction of the difference favors the experimental group.

*For a one-tailed test a critical U value of $\leq$ 65 is statistically significant (.05).

Results As indicated in Table 6 the pre- post-test gain score difference between groups is statistically significant at the .05 level with the direction of the difference favoring the

experimental group. The null hypothesis is, therefore, untenable and H_1 is accepted.

Hypothesis II

H_o: There is no significant difference in perceptual-motor proficiency improvement between the experimental and control groups. H_1: There is a significant improvement in creeping and crawling performance favoring the experimental group.

Analysis The Mann-Whitney U test was employed in a comparison of pre- post-test gain scores between groups.

Table 7 Mann-Whitney U test comparing motor development gain scores between groups

Item	Motor Development
Experimental n_1	13
Control n_2	16
Experimental R_1	205
Control R_2	230
U value	69

Note: Differences between groups on pre- post-test motor development gain scores are not statistically significant.

*For a one-tailed test a critical U value of $\leq$ 65 is statistically significant (.05).

Results As indicated in Table 7 the pre- post-test motor development gain scores between groups is not statistically significant. H_o is, therefore, accepted as the data do not

give evidence which justify rejecting H_o at the set level of significance.

Hypothesis III

H_o: There is no significant difference in mean IQ score improvement between the experimental and control groups.

H_1: There is a significant mean IQ improvement favoring the experimental group.

Analysis In order to compensate for pre-experimental differences in IQ and to control statistically for the lack of randomization, analysis of covariance was employed using pre-test IQ scores as the covariates. Correlation Coefficients between pre-test and post-test IQ scores for the experimental and control groups were $r = .81$ and $r = .95$ respectively.

Table 8 Analysis of Covariance comparing mean IQ improvement between groups

Source of Variation	df	x^2	xy	y^2
treatments	1	3,464.75	1,080.13	330.97
within	27	13,755.25	10,816.87	11,208.25
Total	28	17,279.00	11,897.00	11,539.24

Table 8 (cont.)

Source of Variation	df	ss	ms	F
treatments	1	645.79	645.79	6.2137*
within	26	2,702.10	103.93	
Total	27	3,347.89		

Note: The F ratio equals 6.2137. There are 1 and 26 degrees of freedom. This is a statistically significant difference favoring the experimental group.

*Statistically significant (.05).

Results As indicated in Table 8 the analysis of covariance yielded a significant difference in mean IQ gain score favoring the experimental group. In view of these data H_o is rejected and H_1 is accepted as tenable.

Summary

The statistical tests performed to analyze hypotheses I and III supported the Doman-Delacato theoretical position.

The statistical tests performed to analyze hypothesis II yielded differences between groups that were not statistically significant (.05). Further analysis* of intra-group pre-test, post-test improvement, however, indicates that both groups improved significantly with the direction of improvement favoring

*Refer to Appendix C, Tables 9 and 10.

the control group. As the control group participated in a rigorous physical program of nonspecific activities these data relevant to hypothesis II lended support to the "control" group program and, in addition, supported the Doman-Delacato Theory of Neurological Organization.

SECTION E

DISCUSSION

XV Summary, Conclusions and Implications

The objectives of the study were to determine the effects of a program of physical activities consistent with the Doman-Delacato theoretical position (11, 12, 13, 14) on the physical and intellectual development of trainable mentally retarded children; assessing the Theory of Neurological Organization through application in a public school setting.

Two classes of trainable mentally retarded children previously described as experimental and "control" groups were used in the study. The experimental and the nonspecific activity "control" programs were administered by the staffs of the respective schools. Subjects in each of the two groups were administered pre- and post-tests in order to measure their creeping and crawling ability, motor development (perceptual-motor proficiency) and intelligence.

The statistical tests performed to analyze hypotheses I, II and III lead to the following conclusions, applicable to the children who participated in the study:

(1) The results from hypothesis I supported a very basic assumption of the Doman-Delacato position, i.e., that creeping and crawling performance improves through participation in creeping and crawling activities. Delacato utilizes mobility functioning as a clinical index of Neurological Organization. Neurological Organization, however, implies a concomitant change in cognitive structure and function, not simply improvement in creeping and crawling.

(2) The results from hypothesis II only partially supported an explicit contention of the Doman-Delacato position, i.e.,

that recapitulation of early perceptual-motor developmental sequences is prerequisite to and improves the performance of more sophisticated perceptual-motor skills that are not practiced. The findings from hypothesis II suggest that while ontogenetic-phylogenetic recapitulation of experiences improves the performance of perceptual-motor skills not practiced, these experiences may not be prerequisite for significant improvement to occur. That similar improvement can occur through another type of physical activity program was evidenced by the statistically significant gains of the nonspecific activity "control" group. This improvement may be, in part, due to the fact that the "control" group activity program more nearly resembled the test items on the motor development instrument employed. The results might also be interpreted as support for Kephart's (34, 35, 36) position that is antithetical to ontogenetic-phylogenetic sequences of activities, stressing instead the recapitulation of ontogenetic nonspecific movements. But, Kephart's theoretical position is not supported by hypothesis III.

(3) The results from hypothesis III in view of the findings from hypothesis I further supported the Doman-Delacato theoretical position via the investigation of its practical applicability. In this instance, improvement in creeping and crawling was, indeed, accompanied by a significant improvement in cognitive functioning as reflected in IQ gains.

The three hypotheses were chosen to test the very basic assumptions and practical aspects of the Doman-Delacato Theory of Neurological

Organization as it applies to trainable mentally retarded children. The fact that basic assumptions of the theory were supported and that the experimental treatment had a facilitating effect upon the physical and intellectual development of the children who participated in the experimental group activities cast a favorable light upon the validity of the theory and its potential practical applicability in classes for trainable mentally retarded children.

The principal investigator was unable to find any similar experimental investigations in the literature. The implications of this initial effort clearly point up the need for replication and for larger scale investigations along similar lines.

BIBLIOGRAPHY

1. Allport, Floyd H. Theories of Perception and the Concept of Structure. New York: John Wiley and Sons, 1955.

2. Ammons, R. B., and Ammons, C. H. "Skills," Encyclopedia of Educational Research, ed. Chester W. Harris, Third Edition, 1960.

3. Ayres, Jean A. "Tactile Functions - Their Relation to Hyperactivity and Perceptual Motor Behavior," American Journal of Occupational Therapy, XVIII, No. 1, 1964, 6-11.

4. Brace, D. K. Motor Fitness of Mentally Retarded Boys Relative to National Age Norms. Paper read at the Research Section, American Association for Health, Physical Education, and Recreation Convention, Atlantic City, N. J., March 18, 1961.

5. Brace, D. K. "Motor Learning of Feeble-Minded Girls," Research Quarterly, American Association for Health, Physical Education, and Recreation, December, 1948, 19:4: 269-275.

6. Breckenridge, Marian E. and Lee, Vincent E. Child Development. Philadelphia: Saunders, 1955.

7. Bucher, Charles A. "Health, Physical Education, and Academic Achievement," N.E.A. Journal, May, 1965, 38-40.

8. Connor, Frances P., and Goldberg, I. I. "Opinions of Some Teachers Regarding Their Work with Trainable Children: Implications for Teacher Education," American Journal of Mental Deficiency, 1960, 64, 658-670.

9. Corder, Owens. "Effects of Physical Education on the Intellectual, Physical, and Social Development of Educable Mentally Retarded Boys," Exceptional Children, February, 1966, 357-364.

10. Cruickshank, William M. A Teaching Method for Brain-Injured and Hyperactive Children. Syracuse: Syracuse University Press, 1961.

11. Delacato, Carl H. The Diagnosis and Treatment of Speech and Reading Problems. Springfield: Charles C. Thomas, 1963.

12. Delacato, Carl H. (ed) Neurological Organization and Reading. Springfield, Illinois: Charles C. Thomas, 1966.

13. Delacato, Carl H. The Treatment and Prevention of Reading Problems. Springfield, Illinois: Charles C. Thomas, 1959.

14. Doman, R. J., Spitz, E. B., Zucman, E., Delacato, C. H., and Doman, G. "Children with Severe Brain Injuries," The Journal of The American Medical Association, Vol. 174, September 17, 1960, 257-262.

15. Di Stefano, M. K., Jr., Ellis, N., and Sloan, W. "Motor Proficiency in Mental Defectives," Perceptual-Motor Skills, 1958, 8, 231-234.

16. Dunn, Lloyd, M., and Brooks, Sayde, T. "Peabody Picture Vocabulary Test Performance of Educable Mentally Retarded Children," Training School Bulletin, 1960, 57, 35-40.

17. Dunn, Lloyd, M., and Hottel, John V. "Peabody Picture Vocabulary Test Performance of Trainable Mentally Retarded Children," American Journal of Mental Deficiency, 1961, 65, 448-452.

18. Francis, R. J., and Rarick, G. Lawrence. Motor Characteristics of the Mentally Retarded. No. 1, U.S. Department of Health, Education and Welfare, 1963.

19. Frantz, Robert L. "The Origin of Form Perception," Scientific American, Vol. 204, May, 1961, 66-72.

20. Gesell, Arnold, et al. The First Five Years of Life: A Guide to the Study of the Preschool Child. New York: Harper Brothers, 1940.

21. Getman, G. N. How to Develop Your Child's Intelligence. Luverne, Minnesota, 1962.

22. Getman, G. N., and Kane, Elmer R. The Physiology of Readiness - An Action Program for the Development of Perception for Children. Minneapolis: Programs for Accelerated School Success, 1964.

23. Giaque, C. "Inquiry into the Correlation Between Physical Fitness and Scholastic Standing," Research Quarterly Supplement, VI, March, 1935, 275.

24. Gibson, J. J., and Gibson, Eleanor J. "Perceptual Learning: Differentiation or Enrichment?" Psychological Review, Vol. 62, No. 1, 1955.

25. Glassow, Ruth B. "Motor Development," Encyclopedia of Educational Research, ed. Chester W. Harris, Third Edition, 1960.

26. Hammill, Donald D., and Orvis, C. Irwin. "Factors Affecting Equivolency of PPVT and RSB When Used With Mentally Subnormal Children," American Journal of Mental Deficiency, March, 1967, 71-5, 793-796.

27. Hayden, F. J. Physical Fitness for the Mentally Retarded. Toronto, Canada: Metropolitan Toronto Association for Retarded Children, 1964.

28. Heath, S. R., Jr. "Railwalking Performance As Related to Mental Age and Etiological Types," American Journal of Psychology, 1942 55, 240-247.

29. Hebb, D. O. The Organization of Behavior. New York: John Wiley and Sons, Inc., 1949.

30. Hilgard, Ernest. Conditioning and Learning. New York: Appleton-Century-Croft, Inc., 1961

31. Howe, Clifford E. "A Comparison of Motor Skills of Mentally Retarded and Normal Children," Exceptional Children, Vol. XXV, No. 8, April, 1959, 352-354.

32. Ismail, H. H., Kephart, N. and Cowell, C. "Utilization of Motor Aptitude Tests in Predicting Academic Achievement," Indiana State Board of Health, Contract P. U. 879-64-838, Technical Report No. 1, August, 1963.

33. Jensen, Milton B. "Reading Deficiencies as Related to Cerebral Injury and Neurotic Behavior," Journal of Applied Psychology, XXVII, December, 1943, 535-545.

34. Kephart, Newell C. "Perceptual-Motor Aspects of Learning Disabilities," Exceptional Children, XXXI, No. 4, December, 1964, 201-206.

35. Kephart, Newell C. "The Needs of Teachers for Specialized Information on Perception," The Teacher of Brain Injured Children, ed., William M. Cruickshank, Syracuse, New York: Syracuse University Press, 1966, 171-180.

36. Kephart, Newell C. The Slow Learner in the Classroom. Columbus: Charles E. Merrill, 1960.

37. Kershner, John R., and Bauer, David H. "Neuropsychological and Perceptual-Motor Theories of Treatment for Children with Educational Inadequacies," A Report Prepared by the Bureau of Research, Area of Research and Development, Department of Public Instruction, Commonwealth of Pennsylvania, Harrisburg, September, 1966.

38. Kirk, Samuel A. "Research in Education," Mental Retardation, ed., Harvey A. Stevens and Rick Heber, Chicago: University of Chicago Press, 1964.

39. Langan, J. G. "A Comparison of Motor Proficiency in Middle and Lower Class Educable Mentally Retarded Children," Unpublished doctoral dissertation, Indiana University, 1965.

40. Lillie, David L. "The Effects of Motor Development Lessons in the Motor Proficiency of Preschool Culturally Deprived Children," Unpublished doctoral dissertation, Indiana University, 1966.

41. Llorens, Lela A. et al. "Cognitive-Perceptual-Motor Functions," American Journal of Occupational Therapy, XVIII, No. 5, 1964, 202-208.

42. Luria, A. R. "Dynamic Approach to the Mental Development of the Abnormal Child," Seminar held in Milan, Italy, May 30, 1959, Reported in World Health Organization, 6.

43. Malpass, L. F. "Motor Proficiency in Institutionalized and Non-institutionalized Retarded Children in Normal Children," American Journal on Mental Deficiency, 1960, 64, 1012-1015.

44. Nissen, Henry W., Chow, Kao Liang, and Semmes, Josephine. "Effects of Restricted Opportunity for Tactual, Kinesthetic, and Manipulative Experience on the Behavior of a Chimpanzee," Journal of Psychology, LXIV, No. 4, October, 1951, 485-507.

45. Oliver, James. "The Effects of Physical Conditioning Exercises and Activities on the Mental Characteristics of Educationally Sub-Normal Boys." British Journal of Educational Psychology, June, 1958, 155-165.

46. Rabin, H. M. "The Relationship of Age, Intelligence, and Sex to Motor Proficiency in Mental Defectives," American Journal of Mental Deficiency, Vol. 62, 1957, 507-516.

47. Robbins, Melvyn P. "A Study of the Validity of Delacato's Theory of Neurological Organization," Exceptional Children, April, 1966, 517-523.

48. Show, John H., and Cordts, Harold J. "Athletic Participation and Academic Performance," in Warren R. Johnson (ed) Science and Medicine of Exercise and Sports, New York: Harpers, 1960.

49. Sloan, W. "Motor Proficiency and Intelligence," American Journal of Mental Deficiency, 1951, 55, 394-406.

50. Sprague, Ann. "The Relationship Between Selected Measures of Expressive Language and Motor Skill in Eight-Year-Old Boys." PhD dissertation in physical education, 1960, State University of Iowa, Iowa City, as cited in Completed Research in Health, Physical Education and Recreation, 1961, 51.

51. Stein, J. U. "Physical Fitness of Mentally Retarded Boys Relative to National Age Norms," Rehabilitation Literature, National Society for Crippled Children and Adults, July, 1965, 26:7: 205-208.

52. Stein, J. U. "Physical Fitness in Relation to Intelligence Quotient, Social Distance, and Physique of Intermediate School Mentally Retarded Boys," PhD dissertation, 1965, George Peabody College for Teachers, Nashville, Tennessee.

53. Stein, J. U. "Motor Function and Physical Fitness of the Mentally Retarded," Rehabilitation Literature, August, 1963, 230-242.

54. Thurstone, T. G. "An Evaluation of Educating Mentally Handicapped Children in Special Classes and in Regular Classes," University of North Carolina, January 16, 1961, U. S. Office of Education Cooperative Research Program Project No. 168, (6452).

55. Weber, Robert John. "A Study of the Relationship of Physical Fitness to Success in School and Personality." PhD dissertation in physical education at University of Iowa, 1952.

56. Werner, Heinz, and Wapner, Seymour. "Toward a General Theory of Perception," Psychological Review, 59, 1952, 324-338.

Appendix A

Creeping and Crawling Scale

CREEPING

	possible points per item
1. Arms and legs without pattern	(4.5)
2. Arms and legs in homologous pattern	(4.5)
3. Arms and legs in homolateral pattern	(4.5)
4. Arms and legs in a cross pattern	(4.5)
5. Head in a cross pattern	
a. head turns to up hand	(2)
b. eyes focus on up hand	(2)
6. Coordination and serialization	
a. back stays straight	(1.33)
b. head, arm and legs work in unison	(1.33)
c. body moves forward smoothly	(1.34)
7. Down arm position	
a. below the up arm	(2)
b. elbow is slightly flexed and in line with the shoulder	(2)
8. Up arm position	
a. elbow is slightly flexed and in line with the shoulder	(4)
9. Rear leg	
a. behind the forward leg	(1.33)
b. thighs in line with the hip	(1.33)
c. lower leg dragging foot	(1.34)
10. Forward leg	
a. thigh in line with the hip lifting knee slightly when flexing hip	(1.33)
b. lower leg dragging foot	(1.33)
c. knee in line with the hip	(1.34)
11. Hand position	
a. fingers relaxed	(2)
b. fingers and hand pointing straight ahead	(2)
12. Foot position	
a. relaxed	(2)
b. instep drags along floor	(2)

Total Creeping Score 50

CRAWLING

	possible points per item
1. Arms and legs without pattern	(4.5)
2. Arms and legs in homologous pattern	(4.5)
3. Arms and legs in homolateral pattern	(4.5)
4. Arms and legs in a cross pattern	(4.5)
5. Head in a cross pattern	
a. head turned to the up hand	(2)
b. eyes focus on up hand	(2)
6. Coordination and serialization	
a. body from head to toe flat on the ground	(1.33)
b. head, arm and legs work in unison	(1.33)
c. body moves forward smoothly	(1.34)
7. Down arm position	
a. below the up arm	(2)
b. must not aid forward movement	(2)
8. Up arm position	
a. 90° angle at the shoulder	(2)
b. 90° angle at the elbow	(2)
9. Down leg	
a. extended in line with the spine	(1.33)
b. relaxed	(1.33)
c. must not aid forward motion	(1.34)
10. Up leg	
a. 90° angle at the hip	(2)
b. stay in contact with the floor	(2)
11. Hand position	
a. up arm	
(1) fingers pointing straight ahead	(1)
(2) relaxed	(1)
b. down arm	
(1) relaxed	(1)
c. supination and pronation	(1)
12. Foot position	
a. up leg	
(1) big toe is tucked	(1)
(2) forward movement is gained by this toe	(1)
b. down leg	
(1) relaxed	(1)
(2) instep rests against floor	(1)

Total Crawling Score 50 Total Full-scale Mobility Score 100

Appendix B

Kershner-Dusewicz-Kershner Revision of the Vineland Oseretsky Tests of Motor Development

THE KDK ADAPTATION OF THE VINELAND OSERETSKY MOTOR DEVELOPMENT TESTS

A GROUP TESTING TECHNIQUE

Keith M. Kershner
Russell A. Dusewicz
John R. Kershner

Contents

Introduction 65

Equipment 67

Format

I. Group Standing In Row Form 69

II. Group Standing In Column Form 75

III. Subgroups Seated 81

IV. Subgroups Seated At Table 86

Scoring Sheets 94

Discussion 100

Introduction

Human growth may be seen in terms of three major categories: the physical, the intellectual and the emotional. Scales have been promulgated in each of these areas for the purpose of measuring the capacities and abilities of individuals relative to the normative standards thought to be necessary for the individual's welfare. These instruments of measurement serve both to provide descriptive information and to isolate particular deficiencies so that remediation which will be of benefit to the individual may be prescribed. Of these general characteristics and indigenous to the physical category are the various motor-development scales. This type of test is the concern of the present paper.

An early and influential scale was developed in Russia by N. Oseretsky. This scale has been used as the basis for the development of several subsequent tests and has served in a similar capacity in the formulation of the present adaptation. The Oseretsky tests found translation into English under the sponsorship of Edgar Doll in 1946 via a Portuguese version. In 1948, William Sloan produced the Lincoln Adaptation of the Oseretsky in an attempt to make the items and administration more amenable to American testing conditions. In 1949, Robert Cassell published the Vineland Adaptation with an aim toward providing a measure exhibiting increased simplicity and objectivity. Beginning in 1950, Sloan conducted empirical studies which further contributed to the administrative efficiency and reliability of the tests and resulted in the publication of the Lincoln-Oseretsky scale in 1954.

The present adaptation was undertaken in order to provide a versatile test for the assessment of motor development in children manifesting varying degrees of learning disability. It was further designed

to provide a logical and efficient administrative procedure which can at the same time allow for sufficient demonstration and trials to criterion to obtain a valid and reliable measure. These advantages were found in the group testing technique herein presented. Having tried several variations of this method of administration, it was determined that a procedure employing two administrators for six subjects was maximally efficient, reducing the testing time per subject considerably. The time saved by demonstrating the tasks to a group, rather than to individuals, provides opportunity for communicating the demands of the task more exhaustively to those whose disabilities require it for comprehension, as well as producing a net savings in time. The tasks, primarily based on the Vineland Adaptation, are arranged in a sequence which facilitates testing from the viewpoint of both the administrators and the subjects. The scoring has been designed for maximum interpretability. In summary, it is the aim of this adaptation to provide a procedure and content which may be clear to the administrators and subjects and produce a valid and reliable measure of motor-development.

EQUIPMENT

1. two stop watches - the type with reset buttons

For section one -

2. one roll of masking tape

For section two -

3. one six foot length of one-half inch diameter
4. two or three tennis balls
5. one standard size yard stick

For section three -

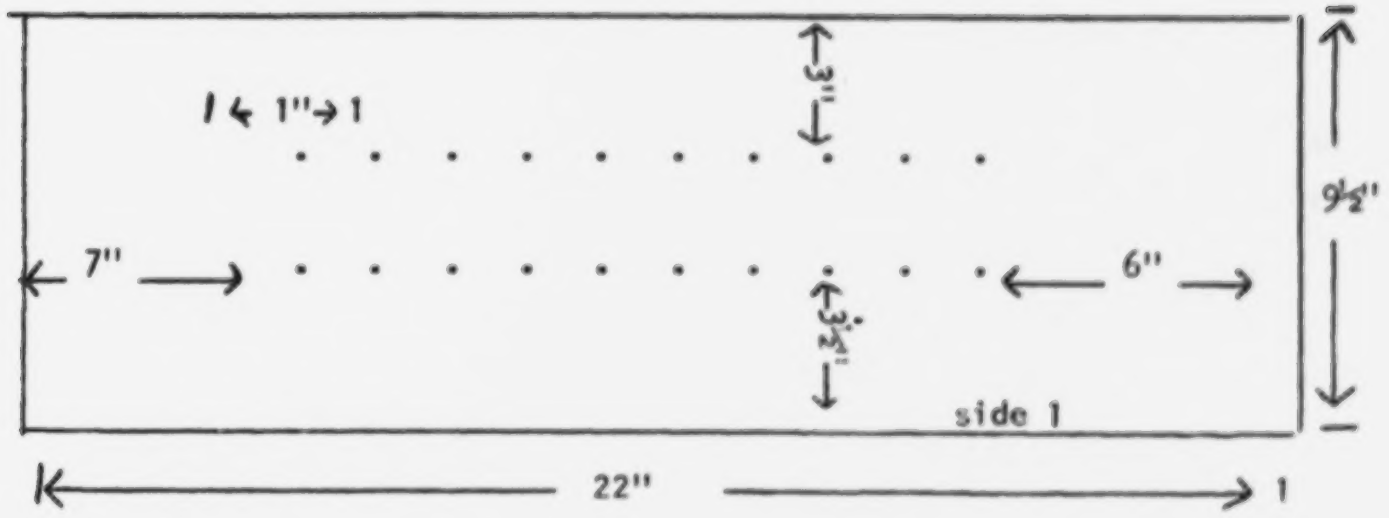
no special materials other than stopwatches needed

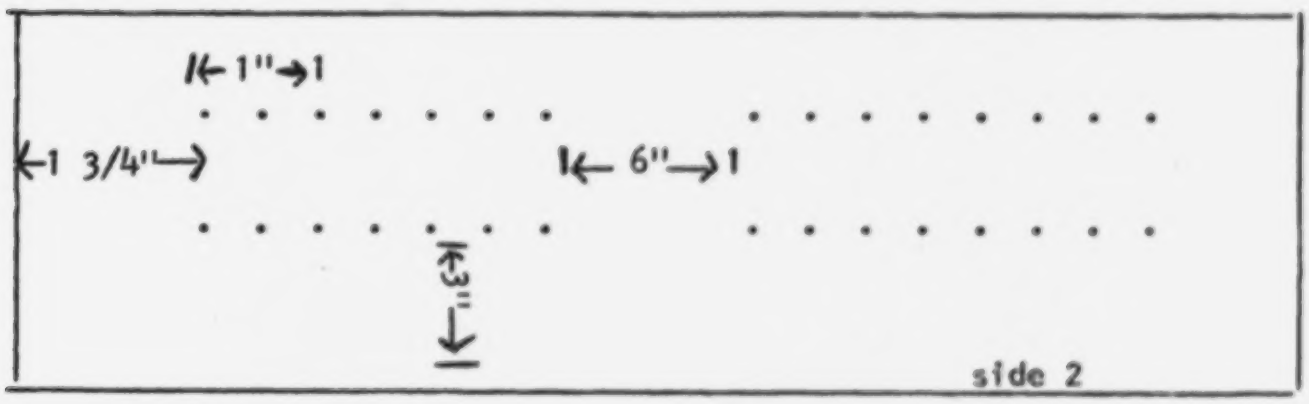
For section four -

6. five round head bolts, 3/4 inches in length, 3/16 inches in diameter and five nuts to fit these bolts
7. two lead pencils
8. 8½ by 5½ inch white paper: about ten sheets per subject
9. one straight deck of playing cards
10. thirty nuts to fit bolts in (6.)
11. a cardboard carton approximately the size of a cigarette carton
12. pattern board A: see accompanying illustration -- This board is fashioned out of ordinary 3/4 inch wood. Each dot on the diagram represents a red dot over which the nuts are to be placed.
13. two knitting needles, 1/16 inches in diameter, 9½ inches in length

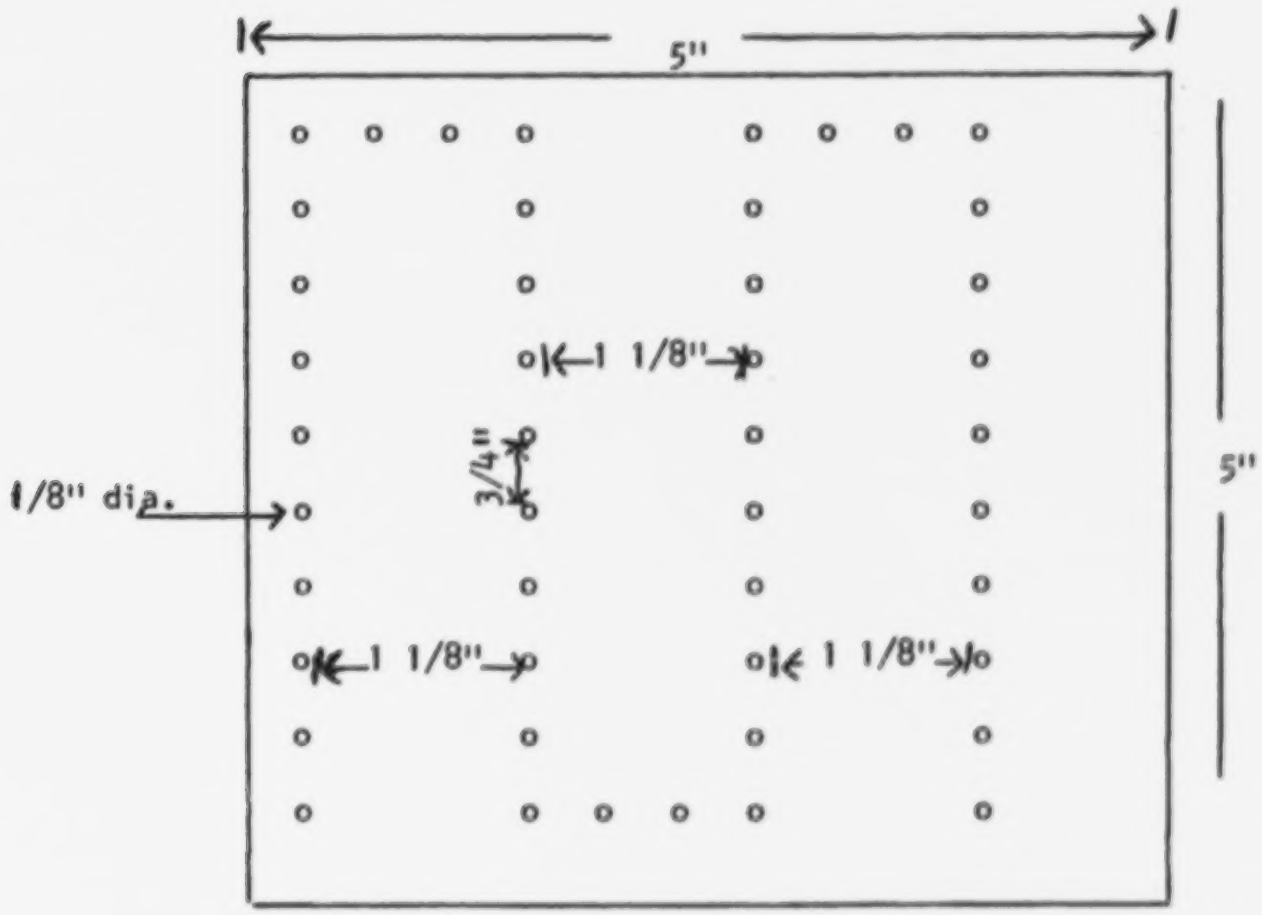
14. pattern board B: see accompanying illustration -- This board is fashioned out of ordinary 3/4 inch wood. Each dot on the diagram represents a hole of 1/8 inches in diameter through which the paper will be punched.
15. a foam rubber pad the size of pattern board B
16. two yards of 16 ply twine
17. cigarette papers: about five per subject

Pattern Board A





Pattern Board B



I. Group Standing In Row Form

The performance of all tasks contained within this section is commenced from the standing position with shoes removed, and most items have a maximum value of 1 point if performed correctly. The tasks are listed in a sequence empirically found to be most economical with respect to total testing time and ease of administration. The suggested administrative procedure is as follows:

a. Arrange all subjects to be tested in such a manner that they are standing side by side in a straight line approximately an arm's length away from each other. This is to insure that the subjects do not have available to them any extraneous means of physical support on tasks which require various degrees of balance.

b. The two test administrators should stand at a distance from the subjects sufficient to allow half of the subjects to fall within visual field of each. Thus each administrator is initially responsible for noting the performance of subjects constituting half of the row. Should additional trials be required for some subjects (as explained below), each administrator will be responsible for scoring half the remainder until such time as the maximum number of trials has been reached or all subjects have performed correctly.

c. Each task is described and demonstrated by one of the administrators. He addresses the group by saying, "Everyone watch me", and when the attention of all subjects has been gained, the task is demonstrated with an accompanying verbal description. He then addresses the group saying, "Now, when I say

'go' I want you to do exactly what I do." For those tasks which are timed, the demonstrator should instruct the subject to continue performance of the task until the command to "stop" has been given. In addition, the demonstrator should call out the number of seconds that have expired but should begin his counting series with the verbal command "go" and end it with the command "stop." Such a counting procedure yields a total time of one second in excess of the required time for any given task. The additional second between the last count and the stop command is a control for premature completion of the task due to anticipation of the terminating command.

d. Subjects who perform the task on the first trial as required are scored positive. Those subjects who are not able to correctly perform the task to the specified criteria are instructed as to what they are doing incorrectly and given another demonstration. They are then tested again. This procedure is followed until a total of four attempts (unless specified differently in the task criteria) are made by each subject on the specific task being tested. Those subjects who at this time have not as yet correctly performed are scored negatively, and the administrators then go on to demonstrate the next task in the section. Each specific trial begins when the administrator gives an initiating command and ends when the subject either satisfies the task criteria or ceases to perform the task correctly.

1. TASK - STAND ON ONE FOOT: Stand with full weight of body on one foot only, hands on hips, eyes open. Then repeat using other foot.

   CRITERION - Score position if subject is able to stand on one foot as directed for 10 seconds without touching other foot to floor, without removing hands from hips, and without hopping. (1 success in four trials; .5 point per leg)

2. TASK - STAND ON ONE FOOT WITH EYES CLOSED: Stand with full weight of body on one foot only, hands on hips, eyes closed. Then repeat using other foot.

   CRITERION - Subject is to be scored positive if able to stand on one foot as described for 10 seconds without touching other foot to floor, without removing hands from hips, without hopping, and without opening eyes. (1 success in four trials; .5 point per leg)

3. TASK - STAND WITH SOLE ON INNER KNEE: Stand on one foot with the sole of the other foot against the inside portion of the supporting knee, bent knee to the side, hands on hips, eyes open. Then repeat using other foot.

   CRITERION - Score positive if subject stands with sole of one foot on inner side of other knee for 10 seconds without removing hands from hips and without hopping. (1 success in four trials; .5 point per leg)

4. TASK - STAND WITH SOLE ON INNER KNEE, EYES CLOSED: Stand on one foot with sole of the other foot against inside portion of supporting knee, bent knee to the side, hands on hips, eyes closed. Then repeat using other foot.

   CRITERION - Score positive if subject stands as directed for 10 seconds without removing hands from hips, without hopping, and without opening eyes. (1 success in four trials; .5 point per leg)

5. TASK - STAND ON TOES: Stand on toes in an upright position, feet together, hands on hips, eyes open.

   CRITERION - Subject is scored positive if subject stands on toes as described for 10 seconds without shifting feet, without hopping, and without touching heels to floor. (1 success in four trials; 1 point)

6. TASK - STAND ON TOES WITH EYES CLOSED: Stand on toes in an upright position, feet together, hands on hips, eyes closed.

   CRITERION - Score positive if subject remains standing on toes for 10 seconds without shifting feet, hopping, touching heels to floor, or opening eyes. (1 success in four trials; 1 point)

7. TASK - STAND ON TOES WHILE BENDING FROM HIPS: Stand on toes while bending from hips to form a ninety degree angle with rest of body so that trunk is parallel to the floor, hands on hips, eyes open.

CRITERION - A positive score is given if subject remains standing as directed for 10 seconds without touching heels to floor, shifting feet, or assuming an upright position. (1 success in four trials; 1 point)

8. TASK - STAND SEMI-CROUCHED ON TOES WITH EYES CLOSED: Stand on toes in a semi-crouched position with eyes closed.

CRITERION - A positive score is given if subject stands semi-crouched on toes as described with feet about six inches apart without shifting them or touching heels to floor. (1 success in four trials; 1 point)

9. TASK - JUMP ON TOES RAPIDLY: Jump up and down rapidly on toes with feet together within a twelve inch square.

CRITERION - Score positive if subject jumps with feet together up and down on toes and only toes for eight times in five seconds. (1 success in four trials; .5 point)

10. TASK - STAND ON TOES OF ONE FOOT: Stand with full weight of body on the toes of one foot only, hands on hips. Then repeat using other foot.

CRITERION - Subject receives a positive score if task is performed as described and subject stands on toes of one foot for 10 seconds without touching other foot to floor, without removing hands from hips and without hopping. (1 success in four trials; .5 per leg)

11. TASK - STAND HEEL TO TOES WITH EYES CLOSED: Stand in an upright position, hands on hips, eyes closed, with one foot placed directly in front of the other so that the heel of the forward foot touches the toe of the other.

CRITERION - Score positive if subject stands heel to toe as directed for 10 seconds without removing hands from hips, opening eyes, or breaking heel-toe contact between feet. (1 success in four trials; 1 point)

II. Group Standing in Column Form

As in the former section, the performance of all tasks in the present section is initiated from the standing position with shoes removed, and the sequence of items is designed for economy of presentation. The suggested administrative procedure is as follows:

a. Arrange all subjects to be tested so that they are standing one in back of the other, single file, forming a straight line.

b. Each task is demonstrated by one of the administrators to the entire group in the same manner as in the preceeding section. The group is told that this is a contest and that the winner will be the one who does the best at performing each of the tasks. Then the first one in line is told to perform the first task listed below. If the performance meets the given criteria, then the subject is reinforced by expression of approval and is instructed to form a new column or line at a distance from the original. The next subject is then tested. If the performance does not meet the given criteria, the subject is then directed to go to the end of the original column and there await another turn. This procedure is to be followed for each of the tasks in this section. The maximum number of turns allowable is task dependent and is specified in the criterion portion of each test item. For timed tasks, the same verbal counting procedure is to be used as that explicated in Section I.

1. TASK - HOP ON ONE FOOT COUNTERCLOCKWISE AROUND CHAIR: Hop on one foot completely around a chair in a counterclockwise direction. Then repeat using other foot.

   CRITERION - Score positive if subject is able to hop around chair as directed without suspended foot touching floor and without any part of body touching chair. (1 success in four trials; .5 point per leg)

2. TASK - RISE FROM CHAIR, LIE BEHIND IT, AND RETURN: Subject assumes an initial sitting position in a straight backed chair. Upon command the subject rises as quickly as possible from the chair, runs around to a position directly behind the chair, lies flat on his back with feet pointing toward the chair, gets up, and then returns to a seated position in the chair. All this is done as quickly as possible.

   CRITERION - On this task the subject is scored on the basis of the amount of time taken in the first correct performance of the task. Thus the subject is given only as many trials as is required (up to a maximum of four) to correctly perform the task as described. Performance time for the first correct trial is recorded and scored as follows (1 success in four trials):

   0 sec. to 5 sec. = 1.50 points

   6 sec. to 10 sec. = 1.00 points

   11 sec. to 15 sec. 0.50 points

   15 sec. + 0.00 points

3. TASK - WALK ALONG LINE HEEL TO TOE: Walk heel to toe, with hands on hips, along a straight line that is two yards long and two inches wide.

   CRITERION - Subject is scored positive if he is able to walk the length of the line as directed, keeping both feet on it for the entire distance and consistently touching the heel of the forward foot to the toe of the other on each step taken. (1 success in four trials; 1 point)

4. TASK - WALK BACKWARDS ALONG LINE HEEL TO TOE: Walk heel to toe with hands on hips, backwards, along a straight line two yards long and two inches wide.

   CRITERION - Score positive if subject is able to walk the length of the line backwards as directed, touching toe of moving foot to heel of stationary foot on each step taken and keeping both feet continually on the line. (1 success in four trials; 1 point)

5. TASK - JUMP IN AIR STRIKING HEELS WITH HANDS: Jump in the air and strike heels with corresponding hands simultaneously before feet touch the floor again.

   CRITERION - Score performance positive if subject strikes each heel with corresponding hand, simultaneously, while in the air as described above. (1 success in four trials; 1 point)

6. TASK - JUMP IN AIR CLAPPING HANDS THREE TIMES: Jump in the air

and clap hands three times before feet touch floor again.

CRITERION - Score positive if subject performs task correctly as directed. (1 success in four trials; 1 point)

7. TASK - JUMP AND TURN 180°, ON TOES: On toes, jump in the air through an angle of 180 degrees making a complete about face, landing on toes, and holding balance on toes for three seconds.

CRITERION - Score positive if subject jumps on toes making 180 degree turn with a single jump as directed and upon landing remains on toes for three seconds without losing balance. (1 success in four trials; 1 point)

8. TASK - JUMP OVER ROPE AT ANKLE HEIGHT: Jump with feet together over a rope placed at ankle height.

CRITERION - A positive score is achieved if subject is able to jump with feet together over the rope. (1 success in four trials; 1 point)

9. TASK - JUMP OVER ROPE MIDWAY BETWEEN ANKLE AND KNEE: Jump with feet together over a rope placed at a height midway between subject's ankle and knee.

CRITERION - A positive score is achieved if subject is able to jump with feet together over the rope. (1 success in four trials; 1 point)

10. TASK - JUMP OVER ROPE AT KNEE HEIGHT: Jump with feet together over a rope placed at knee height, i.e., at a height equivalent to the distance from the floor to the top of the subject's knee.

CRITERION - A positive score is achieved if subject is able to jump with feet together over the rope. (1 success in four trials: 1 point)

11. TASK - BOUNCE BALL AND CATCH WITH ONE HAND: Bounce ball once with one hand and catch it with the same hand. Then repeat using other hand.

CRITERION - Score positive if subject is able to throw a ball against the floor and catch it on one bounce with one hand as directed without the aid of the other hand or any other part of the body. (1 success in four trials: .5 point per hand)

12. TASK - BOUNCE BALL WITH ONE HAND FIVE TIMES WITHOUT CATCHING: Keeping both feet stationary, bounce a ball with one hand five times without catching.

CRITERION - Subject is scored positive if he is able to bounce the ball as described at least five times in succession. Subjects may pivot but must not move both feet completely out of position in order to achieve a positive score. (1 success in four trials: .5 point per hand)

13. TASK - CATCH TOSSED BALL WITH ONE HAND: Catch a ball with one hand when tossed from a distance of three yards. Then repeat

using other hand.

CRITERION - Score positive if subject successfully catches ball with one hand without using any other part of body in assisting the catch. (1 success in four trials; .5 point per hand)

14. TASK - BALANCE YARDSTICK HORIZONTALLY ON FOREFINGER: Balance a yardstick on the broad side, horizontally with the side of one forefinger, the forefinger being extended from an otherwise fisted hand whose palm is positioned perpendicular to the floor.

CRITERION - Score positive if subject is able to initiate balancing of yardstick and then maintain such balance for ten seconds. Administrator should indicate to subject the approximate point of balance on the yardstick. (1 success in four trials; 1 point)

15. TASK - BALANCE YARDSTICK VERTICALLY ON FOREFINGER: Balance yardstick on end, vertically, on the palm side of the tip of one forefinger.

CRITERION - Subject is scored positive if able to initiate balancing of yardstick and then maintain such balance for ten seconds. (1 success in four trials; .5 point)

III. Subgroups seated

In this section the testing group of six subjects is divided into two subgroups. All tasks are performed in a seated position. No special equipment other than two stopwatches are needed. The suggested procedure for administration is as follows:

a. Divide the testing group of 6 subjects into two subgroups of three subjects each. One test administrator will work with each of these groups.

b. The subgroups should be physically separated as much as possible such that the activities of one will not disturb the other.

c. Seating facilities should be available for the subjects and the administrator, as well as adequate table space for scoring purposes.

d. Seat the three subjects of each subgroup next to each other in a line. The two subgroups are tested simultaneously in relative isolation.

e. The administrator is seated such that he faces the subjects and has easy access to the scoring sheets.

f. The administrators address the subjects saying, "Watch what I am going to do." He then demonstrates the task at hand and asks the subjects to try it. After this brief demonstration, he asks the subjects to perform the task, individually or severally in accordance with scoring ease and precision. In this section, since patterns of movement are important elements in most tasks, such verbal instruction as, "Keep moving them (feet, etc.) one at a time.

Tap your fingers with your feet like this. Keep on doing the same thing . . ." will be helpful in eliciting the proper performance.

g. For the tasks requiring performance for ten seconds duration the administrator counts aloud so that the subject is aware of the temporal demands of the task. For the tasks requiring a specific number of units of performance to criterion the administrator enumerates the units as they are accomplished.

h. If they subject performs the task properly in not more than four trials, he is scored positive: one point (one-half point for appropriate items). If he cannot perform the task within the maximum four trials, he is scored negative: zero points.

1. TASK - PIVOT THUMBS AND FOREFINGERS: Place forefinger of one hand (A) on thumb of opposite hand (B). Pivot this finger on thumb until hands are in such a position that the forefinger of hand B meets the thumb of hand A. Pivot the forefinger of hand B on thumb of hand A until hands are in such a position that the forefinger of A again meets thumb of hand B (oridinal position). Continue this pivotal action with eyes closed.

   CRITERION - Score positive if subject can pivot thumbs and forefingers in a continuous manner for ten seconds with eyes closed. (1 success in four trials; 1 point)

2. TASK - ALTERNATE OPENING AND CLOSING OF HANDS: Extend arms straight out in front in a parallel fashion with palms down and hands closed. Open one hand leaving the other closed, then open the second hand closing the first. Alternate opening and closing.

   CRITERION - Score positive if subject can continue this opening and closing for ten seconds. (1 success in four trials; 1 point)

3. TASK - TOUCH FINGERTIPS SUCCESSIVELY WITH THUMB: Extend each hand, and with the thumb of that hand touch each fingertip of that hand in a successive order beginning with the little finger, then reversing the order.

   CRITERION - Score positive if fingertips are touched successively in forward and reverse order, and if only one finger is touched at one time. (1 success in four trials; one half point for each hand)

4. TASK - TAP FEET ALTERNATELY ON FLOOR: Tap feet on floor in an alternating pattern: one foot, then the other.

   CRITERION - Score positive if subject can continue performance for ten seconds without interruption of the described pattern. (1 success in four trials; 1 point)

5. TASK - TAP ALTERNATE FOREFINGERS WITH CORRESPONDING FEET: With hands on knees tap forefingers with corresponding feet as feet are tapped in an alternating manner on floor. Thus, fingers are

tapped in the same pattern with corresponding feet.

CRITERION - Score positive if subject can continue performance for ten seconds without interruption of the described pattern (1 success in four trials; 1 point)

6. TASK - TAP ONE FOOT AND CORRESPONDING FOREFINGER ONCE, OTHER FOOT AND FOREFINGER TWICE: With hands on knees tap one foot and corresponding forefinger once. Then tap other foot and corresponding forefinger twice.

CRITERION - Score positive if subject can continue performance for ten seconds without interruption of modified alternating pattern. (1 success in four trials; 1 point)

7. TASK - TAP FEET ALTERNATELY TAPPING BOTH FOREFINGERS WITH ONE FOOT: With hands on knees tap feet alternately, tapping both forefingers with one foot (either one) and either forefinger with the other. (1 success in four trials; 1 point)

CRITERION - Score positive if subject can continue performance for ten seconds without interruption of modified alternating pattern. (1 success in four trials; 1 point)

8. TASK - DESCRIBE CIRCLES WITH FOREFINGERS: Extend arms out to sides, and, holding arm and wrist joints rigid, describe circles with forefingers.

CRITERION - Score positive if subject can continue circular movement of forefingers for ten seconds without employing movement of hands, wrists, or arms. (1 success in four trials; 1 point)

9. TASK - RUB ABDOMEN AND PAT HEAD: With one hand rub abdomen with circular motion of arm. With other hand pat top of head with up and down motion of arm.

CRITERION - Score positive if both described actions can be performed simultaneously without interruption of pattern for the seconds. (1 success in four trials; 1 point)

10. TASK - FLEX FEET: With arms folded and legs extended flex each foot at the ankle five times.

CRITERION - Score positive if subject can flex each foot independently five times. (1 success in four trials; 1 point, one half point for each foot)

IV. Subgroups seated at table

In this section the testing group of six subjects is again divided into two subgroups. Most tasks are performed in a seated position. All tasks must be performed by one subject at a time as the behavior measured is not in terms of pass or fail, but rather in terms of individual times. The equipment needed is described above. The suggested procedure for administration is as follows:

a. Divide the testing group of six subjects into two subgroups of three subjects each. So that two sets of equipment will not be necessary the tasks in this section have been divided into two sets (tasks 1 through 5 and tasks 6 through 10) requiring approximately the same time to administer. One test administrator works with one subgroup of subjects on the first set of tasks while the other test administrator works with the other subgroup on the second set of tasks. When both have finished, the administrators exchange subgroups of subjects and complete this section in a two-stage process.

b. The subgroups should be physically separated as much as possible such that the activities of one will not interfere with the activities of the other.

c. The three subjects and test administrator of each group are seated around a table which offers enough space for the task performance, task materials, and scoring sheets.

d. The administrator addresses the subjects saying, 'We're going to play some games now. We're going to take turns playing. When it's your turn, you play the game that I show

you as fast as you can." The administrator demonstrates for each task, then asks the subjects to perform in turn, demonstrating further as needed. As these tasks all require a continuing pattern of action, such verbal instruction as, "Keep moving both hands at the same time. Do it as fast as you can . . ." may be helpful during performance. The scoring is in terms of either time per unit performance or performance per unit time. Thus, encouragement during the task is a necessary aid for maintaining the subject's attention and getting a good measure of his ability.

e. If in the midst of task performance the subject deviates from the prescribed pattern, correct him verbally. If this correction results in immediate resumption of correct performance, continue the trial. If, however, further demonstration is needed, a new trial must be run. The maximum number of allowable trials is again four. The first trial performed correctly is scored.

f. The measured times are converted into test points via the tables supplied for each task.

Set One

1. TASK - ASSEMBLE FOUR NUTS AND BOLTS: A nut is placed on a bolt and, while grasping the bolt in one hand the nut is spun with the forefinger of the other hand until it is screwed firmly against the head of the bolt. This procedure is repeated for the remaining three nuts and bolts.

CRITERION - The subjects performance is timed. The score in seconds is converted into points as follows. (1 success in four trials);

000 sec. to 060 sec. = 1.00 point
061 sec. to 120 sec. = .75 points
121 sec. to 180 sec. = .50 points
181 sec. to 240 sec. = .25 points
240 sec. + = .00 points

2. TASK - TAP PENCIL ON PAPER: Subject is asked to pick up a pencil with one hand. He is then to tap the pencil on a 5½ x 8½ inch sheet of paper for ten seconds making as many dots as he can. This procedure is then repeated with the other hand.

CRITERION - The subjects performance is scored by the number of dots he makes in the allotted time. This score is converted into points via the following scale. This is done for each hand, then summed. If a score for one hand only can be obtained, multiply it by two, use the scale, then give half credit. (1 success in four trials)

60 dots + = 1.5 points
50 dots to 59 dots = 1.0 point
40 dots to 49 dots = 0.5 points
00 dots to 39 dots = 0.0 points

3. TASK - TAP PENCILS WITH BOTH HANDS: Subject takes a pencil in each hand and taps them simultaneously for ten seconds on a sheet of paper having a line down the center such that the dots made

by the right pencil are to the right of the line and the dots made by the left pencil are to the left of the line. The tapping must be simultaneous: both pencil points must meet the paper at the same time. If, upon counting the dots, the administrator finds that there is a difference of greater than five between the numbers of dots on the two sides of the paper, then another trial must be given. The maximum number of trials is four.

CRITERION - This task is scored on the basis of the total number of dots made in ten seconds. This total is converted into points as follows. (1 success in four trials);

85 dots +	= 1.00 point
70 dots to 84 dots	= .75 points
55 dots to 69 dots	= .50 points
40 dots to 54 dots	= .25 points
39 dots -	= .00 points

4. SORT 36 CARDS BY COLOR: The administrator shuffles a deck containing 18 black cards and 18 red cards: no face cards. The administrator shows the subject a red ace and a black ace asking him to signify the difference between the two in order to orient the subject to color discrimination. The administrator then says, "We are going to make two piles -- one of red cards, the other of black cards -- beginning with these two aces. I want you to hold the deck of cards face down in one hand and draw them one at a time with the other hand. Look at the card

and, if it is red, put it on this pile (pointing); if it is black, put it here (pointing). Do this as fast as you can." This task is to hold cards face down in one hand, draw one at a time with the other hand, and place on proper color pile. Repeat procedure for other hand.

CRITERION - This task is scored in seconds. The seconds are converted to points, for each hand, as follows. The total score will be the sum of both hands. If score for one hand only can be obtained, multiply it by two, use the scale, then give half credit. (1 success in four trials):

up to 120 sec. = 2.0 points
121 sec. to 150 sec. = 1.5 points
151 sec. to 180 sec. = 1.0 points
181 sec. to 210 sec. = 0.5 points
211 sec. + = 0.0 points

5. TASK - WIND TWINE WHILE WALKING: A two yard piece of twine (a loop having been made at one end) is tied around forefinger of the hand which subject offers for this purpose. Subject is instructed to wind the twine, as fast as he can, around the finger, while all the time walking around the room. Twine must be wound snugly around one finger only. Subject must stay in motion while winding.

CRITERION - This task is scored in seconds. The time is converted into points as follows. (1 success in four trials):

Set Two

6. TASK - PUT TWENTY NUTS IN BOX: Pattern board A (side displaying 20 dots) is placed before subject. Oblong box is situated behind board. Twenty nuts are put on the board, one over each dot. Subject must pick up the nuts one at a time using only one hand and put them in the box. He is to go down one row and up the other as fast as he can. Procedure is repeated for other hand.

CRITERION - This task is scored in seconds. The time for each hand is converted into points as follows. If a score for one hand only can be obtained, multiply it by two, use the scale, then give half credit. (1 success in four trials):

00 sec. to 19 sec. = 2.00 points
20 sec. to 29 sec. = 1.50 points
30 sec. to 39 sec. = 1.00 points
40 sec. to 49 sec. = 0.50 points
50 sec. to 59 sec. = 0.25 points

7. TASK - PUT THIRTY NUTS IN BOX USING BOTH HANDS: Pattern board A (side displaying 30 dots) is placed before subject. Oblong box is situated behind board. Thirty nuts are put on board, one over each dot. Subject must pick up two nuts at a time, one with each hand simultaneously, and put them in the box. Arm movement must be simultaneous. Subject starts from outside and progresses inward.

CRITERION - This task is scored in seconds. The total time for both hands is converted into points as follows. (1 success in four trials):

up to 20 sec. = 1.00 points

21 sec. to 30 sec. = 0.50 points

31 sec. to 40 sec. = 0.25 points

41 sec. + = 0.00 points

8. TASK - PUNCH HOLES THROUGH PATTERN BOARD: A sheet of paper is placed between pattern board B and foam mat. Subject selects knitting needle with one hand. The task is to insert needle into each hole in succession punching a hole in the paper. Subject starts at one end of the design and proceeds as fast as possible to the other end. No more than two holes can be missed or hit out of order for a scored trial.

CRITERION - Task is scored in seconds for each hand. The time for each hand is converted into points as follows. If score for one hand only can be obtained, multiply by two, use scale and give half credit. (1 success in four trials):

00 sec. to 35 sec. = .75 points

36 sec. to 45 sec. = .50 points

46 sec. to 55 sec. = .25 points

56 sec. + = .00 points

9. TASK - PUNCH HOLES THROUGH PATTERN BOARD USING BOTH HANDS: A sheet of paper is placed between pattern board B and foam mat. Subject takes a knitting needle in each hand. The task is to insert needles simultaneously and punch holes in paper. Each hand starts at one end of the design and works toward center.

Movement of arms must be simultaneous. No more than two holes can be missed or hit out of order for a scored trial.

CRITERION - Task is scored in seconds. Total time is converted into points as follows. (1 success in four trials):

up to 30 sec. = 1.00 point

31 sec. to 40 sec. = 0.50 points

41 sec. to 50 sec. = 0.25 points

10. TASK - ROLL PAPER INTO A BALL: Cigarette paper is placed in palm of one hand. Using only the movements of that hand: no rubbing against objects or using other hand. Subject must roll the paper into a tight compact ball. Repeat procedure for other hand.

CRITERION - This task is scored in seconds. Time is stopped when administrator judges ball to be tightly rolled. Time is converted into points for each hand as follows. If score for one hand only can be obtained, multiply by two. use scale, then give half credit. (1 success in four trials):

up to 5 sec. = .50 points

6 sec. to 10 sec. = .37 points

11 sec. to 15 sec. = .25 points

SECTION ONE
GROUP STANDING IN ROW FORM

TASK	Class	Task Classification	Scoring	Total For Item	Prerequisites	Notations
1. stand on one foot		OSC				
2. stand on one foot with eyes closed		OSC			1	
3. stand with sole on inner knee		OSC			1	
4. stand with sole on inner knee, eyes closed		OSC			3	
5. stand on toes		OSC				
6. stand on toes with eyes closed		OSC			5	
7. stand on toes while bending from hips		OSC			5	
8. stand semi-crouched on toes with eyes closed		OSC			5	
9. jump on toes rapidly		OSC				
10. stand on toes of one foot		OSC			1,5	
11. stand heel to toe with eyes closed		OSC				

Date _____ Test _____ Name _____

SECTION T$_{GD}$
GROUP STANDING IN CIRCULAR FORM

TASK	Task Classification	Scoring	Total For Item	Prerequisites	Notations
1. hop on one foot counter clockwise around chair	GDC				
2. rise from chair, lie behind it, and return	Speed				
3. walk along line heel-to-toe	GDC				
4. walk backwards along line heel-to-toe	GDC			3	
5. jump in air striking heels with hands	GDC				
6. jump in air clapping hands three times	GDC				
7. jump and turn 180° on toes	GDC				
8. jump over rope at ankle height	GDC				
9. jump over rope midway between ankle and knee	GDC			8	
10. jump over rope at knee height	GDC			9	
11. bounce ball and catch with one hand	DMC				
12. bounce ball with one hand five times without catching	DMC				
13. catch tossed ball with one hand	DMC				
14. balance yardstick horizontally on forefinger	DMC				
15. balance yardstick vertically on forefinger	DMC			14	

Date _____ Test _____ Name _____

SECTION THREE
SUBJECTS SEATED

TASK	Task Classification	Scoring	Total For Item	Prerequisites	Notations
1. pivot thumbs and forefingers	S.M.C.				
2. alternate opening and closing of hands	S.M.C.				
3. touch fingertips successively with thumbs	S.M.C.				
4. tap feet alternately on floor	S.M.T.			-	
5. tap alternate forefingers with corresponding feet	S.M.T.				
a. tap one foot and corresponding forefinger once, other foot and forefinger twice	S.M.T.			5	
7. tap feet alternately tapping both forefingers with one foot	S.M.T.			5	
8. describe circles with forefingers	S.M.T.				
9. rub abdomen and pat head	S.M.T.				
10. flex feet	G.D.C.				

Date _____ Test _____ Name _____

SECTION FOUR
SUBJECTS SEATED AT TABLE

TASK	Classification	Task	Scoring	Total for Item	Prerequisites	Notations
1. assemble nuts and bolts		D.M.C.				
2. tap pencil on paper		Speed				
3. tap pencil with both hands		S.M.C.				
4. sort 36 cards by color		Speed				
5. wind twine while walking		S.M.C.				
6. put 20 nuts in box		Speed				
7. put 30 nuts in box using both hands		S.M.C.				
8. punch holes through pattern board B		Speed				
9. punch holes using both hands		S.M.C.				
10. roll paper into a ball		S.M.C.				

Date _____ Test _____ _____ Name _____

Score task where indicated by *

	TASK	GSC	GDC	DMC	SMV	SPEED
I	1	*				
	2	*				
	3	*				
	4	*				
	5	*				
	6	*				
	7	*				
	8	*				
	9		*			
	10	*				
	11	*				
II	1		*			
	2		*			*
	3		*			
	4		*			
	5		*			
	6		*			
	7		*			
	8		*			
	9		*			
	10		*			
	11			*		
	12			*		
	13			*		
	14			*		
	15			*		
	Sub Totals:					
	S-T from Sheet A:					
	Totals:					

Grand Total: _____

DATE _____ TEST _____ NAME _____

Score task where indicated by ✲

KDK ADAPTATION OF
VINELAND - OSERETSKY

	TASK	GSC	GED	DMC	SMV	SPEED
III	1			✲		
	2			✲		
	3			✲		
	4				✲	
	5				✲	
	6				✲	
	7				✲	
	8				✲	
	9				✲	
	10		✲			
IV	1			✲		
	2					✲
	3				✲	
	4					✲
	5				✲	
	6					✲
	7				✲	
	8					✲
	9				✲	
	10			✲		

Sub Totals:

DATE_____ TEST_____ NAME_____

Discussion

The KDK version of the Oseretsky Tests for motor development possesses a uniqueness of design which provides numerous advantages over previously existing adaptations and revisions. The present adaptation not only represents a substantial savings in time as a result of its group administration design but also provides for greater item validity and reliability due to its more practical criteria for task performance, chosen for the purpose of reducing error variance resulting from administrative procedure and differential cognitive abilities of subjects tested.

In addition, all special test materials required have been chosen so that they are inexpensive and readily obtainable from a variety of sources.

Although it is not the intent at the present time to provide a complete discussion of the rationale behind the specifics of the KDK adaptation, the authors feel, however, that a more detailed explanation of several important points is at this time warranted.

Group Administration Designs

The expressed design of the KDK Adaptation specifically for group administration obviates the necessity of consuming considerable amounts of time in numerous demonstrations of tasks to each subject individually. The present version requires only a single initial task demonstration and a maximum of three additional ones, should succeeding performance trials be found necessary. Such a group technique also allows subjects to gain cues from observing the performance of other subjects in the group and thus gain a better under-

standing of what is demanded of each task than demonstration by a test administrator could provide.

In addition, performing in a group has been found to greatly aid in reducing subject anxiety and in establishing good administrator - subject rapport.

The presence of a peer group involved in performance of the same tasks creates within each subject a greater and longer lasting attentiveness which serves to counteract the element of fatigue that has traditionally plagued the area of motor development testing and specifically posed serious problems for earlier forms of the Oseretsky Tests. The group atmosphere together with the accompanying reduction in testing time has practically eliminated the fatigue factor in the present version.

Task Classifications:

In accord with other versions, the KDK Adaptation has provided for the division of all items into five major task classifications or constructs representing different areas and levels of motor development as follows:

General Static Coordination

General Dynamic Coordination

Dynamic Manual Coordination

Simultaneous Voluntary Movement

Speed

Each classification has been given equal representation and weighting in the design of the present test, and separate scores for each as well as a combined total score for all five is readily obtainable from the scoring format sheets.

Task Dependency:

The KDK Adaptation provides a systematic method for the reduction of test items based on the principle of dependency. In short, this principle states that if task is dependent upon prerequisite tasks A and B, and a subject is not able to perform either task A or task B or both, then he should not be able to perform task C. Thus, a system of ascending series of task dependancies has been outlined where certain tasks are taken to be prerequisite to the performance of other tasks. Systematically alleviating the necessity of testing multiple dependency tasks when their prerequisites have been found lacking permits an additional economy of testing time which prior to the KDK Adaptation had been non-existent.

The prerequisites for each task are listed on the score sheet as such, and failure in performance of any prerequisite obviates the necessity of testing that item. Instead, it is simply scored negatively by having no points given to it under the scoring column.

Scoring of Timed Items:

Tasks requiring speed of performance are, in the present adaptation, accompanied by special scoring tables which indicate appropriate scores for various possible task performance times. Each table has been empirically derived and has been designed to allow for maximal discriminatability of tasks over subjects. Thus, the relationship between points scored and performance time for each task, although negatively correlated as would be expected, is generally non-linear. Also in line with this concept, the maximum attainable point scores for each task have been assigned on the

basis of the ability of each to differentiate among subjects, the more discriminate items being assigned the greater numbers of points.

Laterality:

In brief, with items that are to be performed first with one side of the body and then with the other, laterality may be determined by noting the side used first. Although the Oseretsky Tests are certainly amenable to laterality determinations, and have in the past been used to such a purpose, very little analysis has previously been provided on this aspect.

The present authors are currently relating their data in this area to laterality determinations made on the basis of other established laterality tests. Further comment as to the relative merits of using this adaptation as the sole means of determining laterality will be reserved until such time as appropriate comparisons with other tests have been made and necessary standardizations or weightings for the various laterality items have been developed.

Appendix C

Mann-Whitney U Test Intra-group
Pre-test, Post-test Motor Development Comparisons

Table 9 Experimental Group

Item	Motor Development
Pre-test n_1	13
Post-test n_2	13
Pre-test R_1	136.00
Post-test R_2	212.00
U value	4.5*

Note: There is a statistically significant pre-test, post-test improvement in motor development for the experimental group.

*For a one-tailed test a critical U value of $\leq$ 28 is statistically significant (.05).

Table 10 Control Group

Item	Motor Development
Pre-test n_1	16
Post-test n_2	16
Pre-test R_1	181.50
Post-test R_2	347.50
U value	45.5*

Note: There is a statistically significant pre-test, post-test improvement in motor development for the control group.

*For a one-tailed test a critical U value of $\leq$ 93 is statistically significant (.05).